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The wonder of the telephone is ever new. The more one considers it, the more surprising does it seem that an insignificant little disc of iron can reproduce so exactly the sounds produced by the highly developed and specialized organs of human speech.

An American syndicate has secured the right to light Paris, and will begin work by bringing together the various lighting interests of that city. The gay city may therefore look forward confidently to a not distant day when it will have a lighting system commensurate with the importance of the French capital.

Reports from Sidney, Cape Breton, are to the effect that Marconi is having difficulty in properly constructing his receiving station and may possibly move to Cape Cod. We should like to see the first permanent transatlantic wireless telegraph station on this side of the Atlantic established in the United States.

THE BRUTE AND THE CIRCUIT.

As electric lines increase in extent the numbers of mishaps caused by animals and birds become more and more prominent. The builders of the telephone and telegraph wires in Mexico first congratulated themselves that the absence of sleet would allow them to economize on the construction, but the ring-tailed monkeys and parrots soon availed themselves of the opportunity to congregate on these lines at night, and a heavier construction became necessary. In like manner, when lines were first built through forests the absence of municipal supervision did not allow the full range of anticipated economies, for the bears, mistaking the humming of the wires for concealed hives of bees, were active in their search for the hidden sweets, gnashing the poles until those of moderate size were severely weakened. And now come the birds to add to the trouble, for the power circuit at Anaheim, in Southern California, was short-circuited by an owl, causing trouble at the power station, and the wires falling upon telegraph wires caused difficulties on those lines.

If the eagles which alighted on wires of opposite polarity in the Fresno power circuits had remained in peace and harmony it would have been better for both birds and plant, but the first blow of a fight caused the simultaneous defeat of both eagles, and the arc short-circuiting the wires made the inevitable trouble at the central station.

A heron recently alighted on the power circuit of the Trenton Falls line, a few miles north of Utica, N. Y., and stepping across from one wire to the other made a burnt offering of himself and trouble again at the central station.

Along the Atlantic coast in eastern New Jersey, the fishhawks establish their nests on the telegraph and telephone poles and defend their homes with such pugnacity that the linemen are obliged to carry sheath-knives in their belts for defence.

The prevention of these occurrences appears to be outside of the functions of circuit-closers and fuses, and may it not be possible that in the near future the owners of electric lines will emulate the farmer and decorate the poles with scarecrow devices; or, perhaps, it may be accomplished by ceasing to make efforts against the youth's throwing the pair of horse chestnuts joined together by a string, like the bolas of the Gauchos in South America? The sentiment of the linemen on this subject may experience a change that will render these festoons a welcome addition.

There are numerous instances of rats causing crosses at switches in electric lighting lines, and some of the fires in the underwriters' bulletins have been ascribed to this cause. It is but a short step from rats to cats, and a cat at Lockport, retreating up the pole of a power line to escape a dog—from the danger she knew to the perils she wot not of—at the cross-arm made a cross from one circuit to the other in such a manner that the arc melted the wire for a long distance, and also caused some difficulty at the power-house at Niagara Falls.

The use of the expression "bugs" for specific trouble is not entirely of ethical significance, because the insects are an omnipresent difficulty for outside lines. The larvæ of small insects, secreting formic acid, have opened circuits by corroding away the fuses. Hornets congregate on the poles and indicate their umbrage at the disturbance, when the lineman opens the door, in a most vigorous manner.

ELECTRIC OPERATION OF TRUNK LINES.

In the current issue of the *North American Review,* Mr. Cornelius Vanderbilt discusses the practicability of using electricity as a motive power on

trunk lines. The author takes up critically the different problems in railway operation, and compares in each case the use of steam and electricity. It is to be regretted that in no case are figures given to back up the conclusions reached, so that the paper can be taken only as an expression of Mr. Vanderbilt's opinion.

In one or two cases certain factors seem to have been overlooked. For instance, it is stated that from the standpoint of those in charge of the railways in this country there is only one object in view when a change is made in methods of operation, this object being the production of an increased net revenue either by a reduction in the cost of transporting freight and passengers, or by providing such additional facilities that higher rates may be charged. If this were the only object in view, it is possible that Mr. Vanderbilt's conclusion that electric operation is not practicable would hold true, at least for a good number of years.

There is another object, however, which has already influenced some railways to decide upon electric operation of certain sections of their roads, namely, that of preventing the loss of traffic which they already enjoy. In passenger traffic, convenience and comfort are all important factors, and when steam railroads have been paralleled by high-speed electric railways—as now seems likely will be the conditions in the future—they will either have to give up this traffic or adopt some system equally as good. The one improvement of doing away with smoke and cinders is enough to draw practically all of this business.

In freight hauling, the tendency has been toward heavier trains, as it has been pretty conclusively demonstrated that this is the most economical method of handling; but the limit in the size of trains has practically been reached for steam operation, owing to the limitations in locomotive construction. Heavier trains of course can be operated by using two or more locomotives, but this method of operation, which has been found so effective in electric railway work, does not seem to have been successful in steam railway operation. This result is, no doubt, largely due to the inability of two engine crews to operate as harmoniously two steam locomotives as can be done by a single motorman by any of the various multiple unit electric systems.

Mr. Vanderbilt states that it has been found from steam railway practice in western states that increased facilities for freight shippers do not, as a rule, pay. He, for this reason, asserts that the increased facilities, which may be possible by the use of an electric system, will count for nothing. We are not prepared to admit this. It may be that the facilities offered in the cases referred to by Mr. Vanderbilt were not great enough. With electrical operation, the railway will be able to distribute freight to all parts of the city by its own express cars, and it would seem that the delivery of goods at the warehouse door would at least count for something.

In comparing the cost of steam and electric systems, Mr. Vanderbilt considers only an extension of our present trolley systems, the power being distributed by alternating currents at high potentials and transformed down at substations into low-voltage direct currents for use on the locomotives. There are few electrical engineers to-day who believe that this will be the solution of the problem, and many are looking forward to the operation of the electric locomotive by alternating currents and thus securing a considerable reduction in the cost of installation.

There are no data to-day for a general comparison of the costs of maintenance of the two systems. But it is not likely that the selection or retention of a system will be decided entirely by the question of cost of operation and of installation. We can all remember the difficulty experienced in persuading the steam roads to adopt the air brake for all cars, and it may be that some influence such as found necessary to bring about this change will again be exerted on the railroads. The day may not be far distant when no steam locomotives will be permitted within the large cities. The roads will then be under the necessity of maintaining two systems or of abandoning steam as a motive power.

Nor is it unlikely that electric railroads, having made a success with local passenger traffic, will try for the through traffic, and we do not doubt that they will get it unless they are fought with their own weapons. How many passengers can a steam road expect to haul when it is paralleled throughout by an electric road which offers a more frequent service, higher speeds and far more comfort? And after having secured the passenger traffic, it does not require a great stretch of the imagination to see the electric roads competing for the freight business as well.

ELECTRICAL FIRE HAZARDS.

The November number of *Insurance Engineering* contains a contribution which, though it is not signed, we are assured comes from a prominent electrical engineer, and in which are discussed the conditions of municipal control of fire hazards at present obtaining in New York city.

The city charter gives the Commissioner of Water Supply, Gas and Electricity cognizance and control over the placing of electric conductors within the city, but no ordinances have yet been passed which enable him to exercise any legal authority in this matter. He therefore stands in an anomalous position, being required to assume the responsibility of maintaining a standard of electrical work in the city, without having the means to enforce his rulings.

Although electrical hazards are, in general, good, the figures given by the last quarterly report of the Electrical Bureau of the National Board of Fire Underwriters show that there is still room for improvement. In this report it is stated that there were 164 fires of electrical origin, entailing a loss of more than $153,000. There were also reported 124 fires, with losses aggregating $1,600,000, "which there is every reason to believe were of electrical origin."

At the present time practically all the local electrical codes are based upon the Underwriters' Code, although this is not altogether satisfactory. Indeed, one set of rules can not be expected to apply equally well in all cases. Risks which it may seem reasonable to allow in small towns may not be permissible in large cities. On the other hand, the expense of construction such as can be reasonably called for in large cities may be far too expensive for small towns. Any set of rules should for these reasons cover broad

principles only, and leave details to the head of the local inspection bureau.

The author of the article referred to above suggests the appointment of an electrical licensing board as probably the best way of securing good work from the contractors. This board, as suggested, would be made up of a representative from the city of New York, a representative from one of the boards of fire underwriters, a member of the American Institute of Electrical Engineers, a representative of the Contractors' Association, and a representative of the Electrical Workers' Union. It is thought that in this way and with rigid inspection, the incompetent contractors can soon be weeded out and their licenses revoked. By far the greater part of poor construction is that done by untrained wiremen, and no contractor will venture to employ such men if he thereby runs a risk of losing his license. Under the present conditions, the only penalty the careless contractor needs fear is the expense of tearing out poor work and replacing it by good.

While many may differ with the suggestion for the solution of the problem as offered, all will agree that some immediate action is needed. Until this is done it will be impossible to keep electrical construction up to the high standard which should be observed.

THE MONORAIL SYSTEM.

Work on the Manchester and Liverpool electric express railway has been begun. This road, joining these two important cities of England, will be thirty-four and one-half miles long. When completed, it is intended that a ten-minute service shall be put in operation at a speed of 110 miles an hour. This speed, allowing for starting and stopping, will cover the distance in twenty minutes.

The road is to be constructed on a monorail system—that is to say, the cars will be suspended on a central rail; but the name is something of a misnomer, as in addition to the rail which carries the weight, four guard rails are used, and, in addition, two conducting rails. The road will therefore be a seven-rail road, if designated in terms similar to those used when referring to the third-rail system.

The selection of this system has been made by the engineer, Mr. F. B. Behr, after much consideration and some experimental work. Mr. Behr claims that he was in no way prejudiced in favor of the monorail system, but was led to his decision because it seemed to him to present many important advantages over the two-rail track for high speeds.

Each car will be supported on four wheels running on the centre rail, and will be held in position by flanged guide wheels bearing on the guide-rails. These wheels will not only prevent excessive lateral vibration, but will also prevent, to a very great degree, vertical play. It is asserted that this construction will make derailment impossible.

The cars are to be operated singly. Each car will be driven by four motors, suspended below the central rail and coupled in pairs through chains to two of the four vertical wheels which sustain the weight of the car.

In addition to the main feature of monorail construction, a number of other new features are included in the plans. Thus, at the terminals, steep grades are provided, which will assist in accelerating cars in starting and retard them when stopping. An electric system is to be installed which will automatically set the block signals as the cars pass the signal stations. The road enters the cities on an elevated structure about sixty feet above the ground, and elaborate plans are shown for these terminal stations. In fact, every feature which can in any way contribute to the success of the road seems to have been considered.

The operation and success of this road will be watched by the whole engineering world with much interest. Although this construction has been experimented with before, this will be the first time for it to be put into practical operation for high speeds. This undertaking will doubtless be viewed with some scepticism by most railway engineers, as it has been found difficult heretofore to provide a sufficiently stable road-bed for such high speeds. There is a general rule in operating railroads to cross bridges and trestles at reduced speeds. This road will be practically one continuous trestle, over which will be run trains at speeds much in excess of those to-day found practicable with the very heaviest track construction.

THE NEW YEAR NUMBER OF THE ELECTRICAL REVIEW.

Following its well-established custom, the ELECTRICAL REVIEW will give in its issue of January 10 a review of the progress made in the electrical industries during the year just closing.

It is well occasionally to pause in the rush and bustle of our active life and take stock, as it were, of what we have on hand in methods and materials, that we may fittingly plan for the future.

As electrical applications multiply and broaden and electrical science advances, each worker, of necessity, becomes more and more a specialist. This is not only inevitable, but it is desirable, for it is the specialist to whom we must look for great advances. Yet the specialist is often hampered because the vast amount of technical literature makes it impossible for him to keep in touch with his brother workers. It is for this reason, and, as well, for the purpose of giving the non-technical reader a clear and comprehensive idea of what has been accomplished, that the ELECTRICAL REVIEW each year goes over the work of the last twelve months. The cooperation of engineers, each not only eminent in his own special branch, but recognized as well for his clear and pleasant style, has been secured for this work. No branch of electrical engineering will be overlooked, and the progress made in this country and abroad will be described.

It is intended to make this issue of the ELECTRICAL REVIEW a milestone in the triumphant march of electricity, and to record in it each year all notable events in electrical matters for the preceding twelve months.

The Telephone Situation of To-Day.

By A. E. Dobbs.

STATISTICAL.

TO ATTEMPT to photograph a moving train or a flying cannon ball without previous preparation may give one a fair idea of the size of the object in question, but no very distinct image. Statistical information of the independent telephone business is much the same kind of undertaking, for the train has acquired full headway and will not stand still long enough for statistics to be written down, so that anything like an accurate count would be about as satisfactory as the calculation of the cubical contents of a moving avalanche or the heat units of a prairie fire.

Strenuous efforts have been put forth by manufacturing concerns to keep in touch with all working exchanges, and two years ago a carefully revised list contained the names of over 5,000 exchanges in actual operation in the United States, while at the present time the list is fully double this number. One weekly journal making a specialty of collecting telephone items publishes about 100 news items per week, of which nearly half relate to newly organized companies throughout the country. Many of these of course never get beyond incorporation, but, nevertheless, men in a position to judge estimate that not less than 100,000 subscribers a year are added to the independent ranks by new companies alone, while with companies already established an average yearly increase of twenty per cent is a modest estimate, a fact hard to realize by one who has not traveled over the field and actually seen this growth from year to year with his own eyes.

In the states of Ohio, Michigan and Indiana, where actual development first began and where the business has assumed a more settled condition than in many other states, there has been an attempt to list and classify the independent exchanges in a book issued by H. H. Robinson, known as the "Telephone Green Book," which gives a summary of all, or nearly all, the exchanges operating in these three states and from which we gather interesting items. Thus in comparative statistics we find:

	Independent Subscribers.	Bell Subscribers.
Ohio	106,344	79,500
Indiana	65,300	35,000
Michigan	33,731	48,930
Total	205,375	163,430

Detailed statistics are given as follows:

OHIO.

Number of exchanges	455
Number of exchange subscribers	92,906
Number of farm line subscribers	13,438
Estimated increase in subscribers for the year	27,027
Total number of subscribers	106,344
Miles of metallic circuit toll lines	16,421
Miles of grounded circuit toll lines	2,503
Increase for the year	34%

INDIANA.

Number of exchanges	177
Number of exchange subscribers	48,947
Number of farm line subscribers	16,353
Estimated increase of subscribers for the year	14,555
Total number of subscribers	65,300
Miles of metallic circuit toll lines	8,208
Miles of grounded circuit toll lines	3,042
Increase for the year	42.5%

MICHIGAN.

Number of exchanges	203
Number of exchange subscribers	27,978
Number of farm line subscribers	5,753
Estimated increase in subscribers for the year	15,369
Total number of subscribers	33,731
Miles of metallic circuit toll lines	5,135
Miles of grounded circuit toll lines	1,756
Increase for the year	84%

These figures were collected the first of last June, and do not represent the exchanges then under construction, or at least those not nearing completion. Taking the total number of subscribers in the three states and the total increase for the year we find that forty per cent represents the total average increase all along the line. As summer is the time of greatest building activity, it is probable that there has been an increase of at least twenty per cent since these statistics were collected.

With this state of affairs is it any wonder that telephone factories are behind their orders, and that there is a living for everybody connected with the business?

It must not be supposed, however, that this increase in business is confined to the three states mentioned. While we have no accurate figures from other states, yet from reports made at state conventions we learn that the states of Wisconsin, Minnesota, South Dakota, Nebraska and Kansas have at the least 125,000 subscribers, and judging from reports of what has been going on in other states, as well as personal knowledge, we may credit Iowa, Missouri and Illinois with at least 175,000 more.

In the East, Pennsylvania has a line of exchanges reaching from Pittsburg to Philadelphia, while New Jersey is being rapidly covered with a network of wires to connect its numerous exchanges together. In New York every important town from Buffalo, where an 18,000-line switchboard is being installed to the very borders of Westchester County, has an independent exchange either building or in actual operation, and in every case the new exchange is taking the lead. In the South and West development is also going on.

In a communication to the *Saturday Evening Post* last June, by W. H. McDonough, who had made a study of every available source of information, 2,500,000 subscribers were claimed for the independents, and the estimate was at the time thought to be very conservative, and if the whole country keeps the forty per cent increase of Ohio, Indiana and Michigan, there can not be very far from 3,000,000 subscribers in the country by this time. If these figures are thought to be too high, the business will overtake them before any more exact data can be obtained.

Referring again to the "Green Book" for the capitalization of exchanges in the three states already mentioned, we find as follows:

	Capital Stock.	Bonded Indebtedness.
Ohio	$26,000,000	$8,967,000
Indiana	4,311,000	451,000
Michigan (outside Detroit)	3,000,000	241,000
Total	$33,311,000	$9,659,000

Percentage of bonded indebtedness = 29%.

From this it will be seen that the companies can not be in a bad condition financially, a detailed examination showing that the majority of them have no outstanding indebtedness at all.

THE LESSONS LEARNED.

It was not to be supposed that the vast number of amateurs who entered the field under these conditions made no mistakes, nor is it to be supposed that first-class manufacturing ability and engineering talent have always guided the construction of these plants. Many very laughable stories are told of the mistakes and ignorance often displayed by men who, without previous experience, had broken into the telephone pasture. And yet, for all that, they succeeded in spite of themselves, the demand for telephones being so great that with plant once started the most obtuse manager was surprised to find the demand outgrowing the capacity of his exchange and that rebuilding was necessary in order to keep up with his subscribers. By this time he had generally learned something by experience and obtained advice from some one who knew more than he did and possibly secured the

services of one or more good linemen to take charge of his work. Linemen, while they greatly improved the character of the work and would put up pole lines in the proper manner, were not always gifted with engineering foresight, and though the most successful managers gave their men *carte blanche* in regard to laying out and executing the work, still mistakes were often made that were expensive in their final results.

Linemen in those days had acquired all their knowledge of telephone work from the Bell company, and five years ago, to build a line of poles "as good as the Bell," was the limit of the average manager's ambition. In some cases where the older plant was about ready to fall down they built "better than the Bell." In those days (five years seem like a long time in the telephone business) grounded lines were the rule rather than the exception, and an exchange putting up a copper return wire was considered far in advance of the general run. Of the larger exchanges, nearly all were connected to a common return system by the newcomers in the field. Instruments were of a very inferior quality, but, nevertheless, the public loyally supported the young aspirant for telephonic business, and does so yet, as is proved by the fact that exchanges established in 1895 are still making steady gains year by year, and extending their business as rapidly in proportion to the territory they have left as the very youngest of them. Had the older company recognized their competitors as engaged in a legitimate business, instead of treating them as outlaws, and either sold them instruments outright or at least offered them the privilege of toll-line and long-distance connections, they might have lost a few exchange connections, but they would have held the key to the situation and the cream of the business; but as they would do neither, independent manufacturers were given every opportunity to improve their instruments and establish their business till at the present time some of their instruments compare favorably with the best of the older kind, and, in the school of experience, the young stripling has learned how to build lines as good as the best that the older company possesses and has established toll lines of his own that are rapidly connecting all of the exchanges together, as may be judged by the fact that in the three states above mentioned there are 37,000 miles of long-distance and toll lines, of which 30,000 are metallic circuits. Four years ago most of the independent exchanges would have been glad to have made arrangements with the older company for an interchange of long-distance business, now they have lines of their own and do not wish to do so.

Mistake No. 2—This has been discussed before, but it can not be too strongly impressed upon those just entering the telephone field. Few of the earlier exchanges realized the proportions to which their business would attain, and in hundreds of cases plants that were built for an ultimate capacity of 200 to 300 lines have grown to have an exchange list of from 500 to 1,000 lines. The writer has said before, and now says it again, that in the laying out of an exchange the only safe limit is the number of families in the town and tributary country, and an exchange laid out on this plan, while it need not string all its wires at the beginning, will save money in the end and have little trouble in rebuilding.

Take Ohio for example—Allowing for an increase of 20,000 subscribers since June 1, which is less than twenty per cent, there is at the present time one independent telephone to every eighth voter throughout the state (number about 1,000,000), and Cincinnati not yet touched; and this, in spite of the fact that the embarrassment of the Everett-Moore Syndicate gave a number of the organized companies a temporary setback during the last year.

Is it any wonder that manufacturers of telephone material are feeling cheerful, while the owners of some exchanges are wondering when this sort of expansion is going to stop and give them time to breathe.

CONCLUSION.

It must not be supposed from all this that the American Bell company has been run out of the field. Far from it, for their splendid long-distance service if nothing else would enable them to hold the ground, but as a matter of fact it is likewise increasing its business at a steady rate—though nothing like that of the independents—building its latest exchanges in the best possible manner and using its best apparatus. But there is still a strong feeling of resentment against it, for its sins of omission and commission in the past and people almost invariably take strong sides with the new companies.

It might have been supposed that this feeling would wear off in a year or two, and the company giving the lowest rates and the best service would secure the bulk of the business, for the public is supposed to have a short memory. But, as a matter of fact, in places where the fight has gone on for seven years the independents are in a better position today than ever and still maintain a long lead in spite of the cheap service party lines, and in some cases free service, inaugurated by the older company. It seems for once the people either have a long memory or else local pride in their home organization, owned and officered by men they know, is not to be left out of the calculation. Besides, in smaller exchanges, the older company does not always give the best service, and their multi-party-line measured service system has not proved popular when put in competition with the single-line unlimited service system of their opponents.

On the other hand, the independents have some faults of their own. With toll lines connecting their exchanges they should immediately take steps to standardize construction and apparatus, not with a view to stifling competition, but with a view to results no matter how attained. Thus the national or state associations might appoint a board to pass on all instruments offered for sale by manufacturers, and any instruments not passing certain well-known tests would not be placed on the official list of approved instruments. Such a board would pass on the mechanical features, talking qualities and its behavior on an artificial line equal to, say, 1,000 miles in length. Any instrument passing satisfactory tests would be placed on the list recommended by the association, and those not doing so would simply be left off.

Line construction should also receive more attention, so that when efforts are made to reach an exchange subscribers would be reasonably sure of obtaining a good talking service when connected.

There are also at the present time, in some rural districts, considerable rivalry and bickering over the fancied rights of some small companies whose exchanges, if combined, would not have subscribers enough to make one good exchange, but until they are consolidated or human nature is changed we suppose this must continue while their subscribers put up with an indifferent service. To remedy the poor construction of some country exchanges, it would not be a bad idea for the toll-line companies to refuse them connections till their lines are placed in proper condition.

Meanwhile the latest exchanges are being built along broad lines with a view to their future development and of the highest grade of construction.

The matter of rates is becoming an acute one in some quarters, for rates that were remunerative in the beginning are hardly so when the exchange has grown from two to five times the original capacity planned for. Unquestionably the rates fixed by some of the independent exchanges are too low for their present capacity, but raising rates is hard work unless done in the guise of measured service, and that does not seem to be popular, while to raise the flat rates is apt to expose the company, that made a campaign for lower rates, to a certain amount of ridicule as well as to encounter violent opposition.

There is also a tendency toward a consolidation of interests, small town exchanges in the same neighborhood merging into one company and county exchanges combining for their mutual benefit, and it is possible we may have all local companies pooling all their stock and forming state associations or syndicates. Be that as it may, independent exchanges are becoming more firmly established every day, and that husky, hustling, hopeful crowd has every cause to take a cheerful view of the future, and for such I would suggest as a watchword: A telephone in every house and every place of business.

The Automatic Telephone Exchange.

By Joseph B. Baker.

THE history of electrical development has accustomed the public to expect large results, often amounting to industrial revolutions, whenever a new method or appliance is perfected. The extent of the revolution that follows a real improvement is only limited, especially in this country, by the extent to which the instance of traffic or manufacture affected reaches into the industrial life. Such a revolution is, in the writer's view, impending in communication traffic by the telephone; automatic machine handling is coming to its own, and bringing the conduct of this vast service into harmony with other public utilities of like magnitude.

Telephone engineers, with their education and practice wholly in systems using "manual" or hand-operated switchboards, have sweepingly denied the possibility of a practical, working automatic telephone exchange adapted to the requirements of a large community, although some have grudgingly admitted the desirability of such a scheme. Even now, with the working of the oldest and most perfect of the mechanical switchboards an accomplished fact, as demonstrated in several brilliantly successful plants, the average "telephone man" will bring up in discussion old and outworn criticisms, familiar by hearsay and repetition for many years. Conservatism and bias are not the only causes of this arbitrary attitude. The prevalence of grossly inaccurate impressions is due largely to the fact that the situation has moved rapidly of late from the debatable into the actual, convincing men of financial and constructive weight who are acting upon their opportunities rather than attracting the attention of the rank and file of telephone men accustomed to passing upon a new system by its value as an improvement in manual operating. The Fall River, Mass., Automatic Telephone Company, using the Strowger system, has more than doubled its original number of 450 subscribers at its start of service in October, 1901; gives an immensely popular service, is growing rapidly and is a commercial success. Using an automatic telephone in that city or in New Bedford, Mass., or in the town of Westerly, R. I., where service was begun October 23, 1902, is a most gratifying experience, and the subscribers are only too glad to tell of its high efficiency. These plants are the advance guard of a new movement in telephony, a breaking of new ground from the start, in which old traditions are swept away, and this form of electric communication traffic is at last harmonized in conduct with other public services of like magnitude, and made a partaker of like efficiency and economy. It is not necessary to wait for the automatic exchanges recently ordered for the cities of Columbus and Dayton, Ohio, nor for the greater automatic system now under active construction in Chicago, to show that a traffic of such enormous volume as that of the telephone—expressed by a Bell telephone report in the statement that an average of over 7,000,000 daily Bell calls alone were made during the year 1901—should be handled by machine rather than by a pair of hands.

The growth of the telephone service has meant rapidly growing systems wherein the pressure of difficult problems confronting the operating companies was, very naturally, met by taking the most expedient step in the way of improvement and expansion. The urgent need of a more efficient service, contingent upon such marvelous growth as that of the last four to six years, during which period the number of Bell telephones has increased at the rate of about twenty-five per cent per year, and the number of independent telephones has increased from practically zero to a number at least equal to the present number of Bell instruments, has, perhaps, compelled engineers and managers, bearing the brunt of such emergency work, to hold the situation, so to speak, by simply putting in more operators and more new devices to assist the operator. That is, the large operating plants, while becoming very complex by the introduction of special circuits and appliances used as hand-tools, have drifted further and further away from being themselves machines. Whereas, such a growth of traffic would elsewhere imperatively indicate a machine to handle it, the largest telephone aggregations are to-day conducted on the same lines as the smallest ones, with the exception that the labor is specialized and the hand implements are more numerous. It is like trying to do the work of a factory by using, instead of modern machinery, a multitude of hand workmen. The workman's bench and the hand telephone operator's table are alike, for the day of small things or for special conditions are numerically negligible in any broad consideration. The large telephone traffic of to-day, and, more especially, the enormous traffic of to-morrow, are not propositions that can be dealt with by a pair of hands depended upon to perform the essential movements. It must be borne in mind that the telephone conditions of to-day differ in kind as well as in degree from those that obtained when the public of telephone users was small, and no thought was given to loss of time in grinding a crank and calling out: "Hello, Central!" and that up-to-date telephone service ought to mean immediate and constant availability of the telephone as a means of intercommunication. The transmission of intelligence that should be given is perfectly capable of being executed with electric quickness for the whole proposition, and should not be so slowed down and hampered in every process but the actual transmission of the voice, as it now is by a clumsy process of signaling, verbal giving of the order for the connection, and manual placing of one pair of wires in contact with another pair. The use of hand labor becomes more than absurd under what are now called "rush conditions," wherein the human operative becomes still more of a misfit in the work by having her attention not only subdivided as a whole, but also impaired in the share each "party calling" can get.

In Fall River the automatic telephones give a service that is a perfect revelation to new users by being simply business-like. It is no fault of the human operator that her manual exchange can not equal the service given at any instant of the day or night by the automatic. The fact is that telephone operating (not including toll-line operating, where supervision is necessary because a record of the calls must be made) is a machine's job: there is nothing about a local operator's functions that is not, essentially, a mechanical movement following a definite cause. When one goes to an automatic telephone, he passes his call in a way requiring less volition than to give it verbally; and, further, his passing of the call also executes it simultaneously. It is enough to compare this process with that of signaling the operator in a "manual" parallel case; waiting for her to plug in

and give you a share of her attention, which you answer by a verbal expression of the number, followed almost inevitably by her questioning repetition and your acknowledgment or correction. All this being done, she laboriously reaches for "the other plug" and places it in a spring-jack; at which stage the call is no further advanced than, with the automatic telephone, it was directly upon the vastly simpler giving of the order; the machine at central, being a real machine and not a combination of one-twentieth of an operator plus an aggregate of hand devices, evading all need for the acknowledging of an order which it can not mistake and instantly executes. To pass on: The next step is to ring the "party called." This is done at the automatic telephone by the party calling, with no uncertain dependence on an operator. The few seconds he waits the party calling knows are chargeable to party called, as time consumed in "answering his telephone." If party called is actually busy, the calling telephone is made aware of it by a buzz in his receiver. But with the manual system, when the operator has "tested the line," and, to enable her to hurry her attention elsewhere plugs party calling into a relentless phonograph circuit, it means no more to him than that the party called may be talking elsewhere or may have "hung up" many seconds ago, and it means no less, certainly, than a vexation, and helpless delay that encumbers his telephone, his clearing-out signal ultimately calling the attention of an operator and releasing his line for a new connection. To complete this comparison—the longer discussion of which would but make plainer the faults of the manual system—consider both the calls to be over at the same time. The hang-up on the automatic set instantaneously clears both calling and called lines, making them available for new connections simultaneously with the hook movement. The hang-up or ring-off by the manual subscriber sets a signal, attention to which, after a varying delay, causes his line to be freed by the operator, with plenty of chances meantime for the "busy test" to falsely inform other parties seeking entrance to his "telephone door."

The proper way to perform a correct estimate of the present and future value of automatic operating is, in the writer's opinion, to point out the defects of the manual system of handling the telephone traffic. The fundamental idea of machine trunking and connecting executed by numbered impulses from the substation has always been a good idea, and now for some time the apparatus to carry out that idea has been in existence in practical working shape. A daily traffic that must be expressed in millions belongs by right to a machine, and a properly designed machine has no use for the multiplicity of cords and plugs, multiplied terminals, extra trunks, and special devices that go with the employment of hand operatives and stand as idle capital nine-tenths of the time because during one-tenth of the time they are required by a highly inefficient and primitive method of handling a big proposition. To deny this to-day in the face of what is being done at Fall River, for example, is merely to shut one's eyes to a new truth of an industrial importance impossible to overestimate. The rapidity of the drift of intelligence is the thing, and of this whole proposition the actual operating is a vital part.

EXPORTATION OF MANUFACTURES.

The fact that the exportation of manufactures this year is larger than in any preceding year except 1900, and that the importation of manufacturers' materials is also larger than in any preceding year, lends interest to a statement just prepared by the Treasury Department of Statistics showing the details of exports of manufactures.

The principal manufactures exported are: iron and steel, mineral oils, copper, leather, cotton, agricultural implements, chemicals, wood, paper, paraffin, tobacco, fibres, cars and carriages, india-rubber goods, books and other printed matter, distilled spirits and musical instruments—their relative value being in the order named.

The Bureau of Statistics has prepared a statement showing the exportation of these great groups of manufactures and the importation of the great groups of manufacturers' materials in the ten months ending with October, 1902, compared with the corresponding period of last year. It shows that exports of iron and steel manufactures for the ten months ending with October, 1902, were $81,977,545 against $85,911,774 in the corresponding months of last year; exports of mineral oils were $51,175,361 against $55,140,398 in the corresponding months of last year; exports of copper were $40,237,345 against $28,176,263 in the corresponding months of last year; exports and manufactures of leather were $25,412,536 against $24,115,932 in the corresponding months of last year; exports of cotton manufactures were $28,853,131 against $21,871,264 in the same months of 1901; exports of agricultural implements were $16,246,556 against $15,812,144 in the corresponding months of last year; chemicals, drugs, medicines, etc., were $11,199,111 against $12,006,510 in the corresponding months of last year; manufactures of wood were $10,410,430 against $9,216,197 in the corresponding months of 1901, and paper and manufactures of were $6,200,163 against $6,145,705 in the same months of last year.

A series of tables has been prepared by the Treasury Bureau of Statistics, showing the exportation of manufactures in each year from 1790 to 1902, and the distribution of each article to every country and grand division of the world during the period from 1891 to 1901, and this analysis shows that fifty-two per cent of the manufactures go to Europe, and twenty-four per cent to North American countries other than the United States.

The exports of manufactures amounted, in 1790, to $1,237,393 and formed 6.1 per cent of the total domestic exports; during the period of 1790-1800 they averaged $1,972,583 per annum, and formed 6.6 per cent of the total; during the decade ending with 1810 they averaged $3,035,541 per annum, and formed 8.9 per cent of the total domestic exports; during the decade ending with 1820 they averaged $3,056,919 per annum and formed 6.6 per cent of the total domestic exports; during the decade ending with 1830 they averaged $6,021,636 per annum and formed 11.3 per cent of the total domestic exports; during the decade ending with 1840 they averaged $8,256,786 per annum and formed 9.3 per cent of the total domestic exports; during the decade ending with 1850 they averaged $12,098,712 per annum and formed 10.8 per cent of the total; during the decade ending with 1860 they averaged $27,407,473 per annum and formed 11.8 per cent of total; during the decade ending with 1870 they averaged $38,362,268 per annum and formed 16.1 per cent of the total. From that period forward the growth was very much more rapid; during the decade ending with 1880 they averaged $92,792,242 per annum and formed 16.1 per cent of the total; during the decade ending with 1890 they averaged $136,017,112 per annum and formed 18.1 per cent of the total exports; during the decade ending with 1900 they averaged $242,278,374 per annum and formed 23.5 per cent of the total; in the fiscal year 1900 they were $433,854,756 and formed 31.6 per cent of the total exports; in the fiscal year 1901 they were $410,932,524, forming 28.1 per cent of the total, and in the fiscal year 1902 they were $403,641,401 and formed 29.8 per cent of the total.

Interstate Independent Telephone Association.

Second Annual Convention Held at Chicago, December 9, 10, 11, 1902.

THE second annual convention of the Interstate Independent Telephone Association opened with a magnificent attendance and sentiment of the utmost harmony. Delegates from the nine states in the organization and manufacturers from every part of the country were present in force.

The first session was called to order on Tuesday morning, with President H. C. Raney in the chair, assisted by Secretary E. M. Coleman.

President Raney called the convention to order, when J. W. Keelyn, chairman of the Chicago entertainment committee, introduced the Hon. Lawrence E. McGann, controller of the city of Chicago, who, as the representative of the Mayor, delivered the address of welcome to the delegates, saying, in part, as follows:

Mr. Chairman and gentlemen of the Interstate Independent Telephone Association—I am here to present the compliments of his honor, the Mayor, and to say that he regrets that he can not be present with you, and to wish that your deliberations may be fruitful of good results. Personally I sincerely wish you the greatest possible success, and I wish to modify my first expression that my interest is not in you as much as in the laborers and people at large. I hope you will always be well paid for your efforts, but I emphasize what I said first that I am more interested in the outcome to humanity. I hope your stay in Chicago will be pleasant, and I extend to you, in the name of the city of Chicago, a hearty welcome. (Applause.)

President Raney then read his address, an abstract of which follows:

President J. C. Raney, of Fairfield, Iowa, on behalf of the Association, thanked the controller for his generous welcome. He remarked that as the Association represented nine states and an investment of at least one hundred millions, it was worthy of such a welcome as it had received.

In calling the Association to order the president outlined the work to be done. The active work of the convention could be divided into three heads; the business relations with the general public, the business relations of the members of the Association with each other and the business relations with and standing in the financial world.

As to the relations of the Association to the public, it must be remembered that they were of the people and that they should preserve intact the cordial relations existing between the people and the independent telephone movement, and while rates should be adequate the public should be treated so as to obtain their good-will and interest. The president thought that one benefit of meetings of this kind should be the opportunity for education to the public. There is vast room for improvement in the relations of the members of the Association to each other. There is room for all and each must respect the rights of the other. Improved business methods were demanded among telephone operators and there is an imperative demand for some accurate method of settling joint business between companies furnishing a joint service.

In the early history of the independent telephone movement the financial question was not a serious one as, in general, the local company could find abundant local capital, but the experience of the smaller companies has been that in order to protect the investment already made they must extend their service to adjoining towns, and for this reason, in many instances, the financial question has become a serious one. Yet, notwithstanding, the independent telephone business has already attained a most enviable financial standing.

The future of the independent companies is in their own hands. A careful conservative course will put them on a firm financial foundation.

In conclusion the president congratulated the members of the Association on the success of their business and urged the consideration and adoption of such plans and policies as would ensure a future history as bright and as honorable as the past.

President Raney: Gentlemen of the convention, I think there are a number who have registered who are not here, and a great many more are expected here tonight and in the morning. Our programme for the rest of the day consists of reports of committees and officers. I would like to ask if the executive committee has a report prepared.

Senator Hull: So far as I know the executive committee, as a committee, has had no meeting since the last interstate convention. There has been some members who have done some work.

President Raney: The next thing in order is the report of the secretary; we will hear that report.

Secretary Coleman read the following report:

SECRETARY'S ANNUAL REPORT.

In submitting this report as secretary of this Association, it is impossible to make a very concise and systematic report, for the reason that when elected as secretary there were no records except of the last meeting by which to be guided. In fact, the Association was simply in the embryo, or formative state, and it became imperative that your secretary should bring system out of chaos. Our executive board being scattered throughout the states embraced in this Association, could not be consulted at all times about what was best to be done, hence the only thing that could be done legitimately, was to adopt such plans as were best calculated to bring about the desired results, submit them to your president, who lives in Iowa, for his approval, and then proceed to carry out such plans as were determined upon. Other matters that made conditions more perplexing were, that such plans and methods as were calculated to interest three distinct classes of men had to be adopted, *viz.*, first, owners and operators of exchanges and toll lines; second, the manufacturers of the various kinds of equipment used in exchanges and toll lines; third, those men who are engaged exclusively in the supply business; that is, who handle the various materials employed in the construction, but do not manufacture.

Your secretary is pleased to report that the manufacturers and supply houses took hold of the proposition with a ready, willing and lavish hand, they having called several meetings and organized thoroughly, appointing special committees and selecting officers for these committees, so that the work has been very persistently and systematically carried on, as you will discover before the close of this convention.

After a conference of the officers and executive board on the night of September 9, the committee appointed on entertainment together with the manufacturers and supply houses of this city worked incessantly to get matters in shape, so that as soon as it was possible a very attractive programme and notice were prepared and 4,000 of them mailed out all over the nine states of this Association. . . . thus making a personal appeal to secure their attendance at this meeting.

Another plan devised for the purpose of creating interest in this Association, and at the same time economize, was the preparation and publication of an official handbook or souvenir to be distributed at this convention—and let me state right here that there was no intention of invading the field now so thoroughly and efficiently covered by the independent telephone magazines and journals—a contract was made with the printers to have the work ready for distribution at this convention, but many of the men to whom letters were written for their photographs and many firms from whom advertisements had been secured failed to send photographs and copy in time to get the work ready, and it has been suggested that the work would be more valuable and interesting if it contained the proceedings of this convention, hence the work will now be issued between the first and the fifteenth of January 1903.

One point your secretary was asked officially, but which he did not feel authorized to decide, was raised by the application of a certain company for membership which has a contract for connection with the Bell company—and it is now using transmitters and receivers furnished by that company—although in its letter—which I will submit if the convention so desires—it admits it is called a traitor by the independent people and yet still claims to be independent.

There are three points to which your secretary would call especial attention and which he thinks should be discussed.

First. The establishment of some feasible plan for the exchange of business or a clearing house. The need of such an arrangement is certainly felt all over the territory of this Association.

Second. The establishment of an information bureau, the object of which is to educate the public so that financiers and moneyed men may not be misguided by the fabulous, ridiculous and false publications scattered all over this country by our opponents.

Third. This Association should determine whether or not any person, firm or corporation operating an exchange, no matter if it begun as entirely independent, but has entered into any kind of contract with the Bell company for connection in any way by which it uses the transmitters and receivers of that company is entitled to membership in this Association.

Your secretary has gathered the following data which he thinks will be very gratifying to the members of this Association:

First. There are in the nine states in-

cluded in this Association something over 3,000 independent telephone exchanges in operation.

Second. While your secretary has not been able to get the exact number of miles of toll lines, yet it is not an exaggeration to say that there are thousands of miles of such lines within the limits of the nine states.

Third. There is over $100,000,000 invested in the independent business within the nine states, not including manufacturing plants.

Fourth. The manufacturing plants of Chicago alone produce and sell $20,000,000 worth of material a year in the construction of telephone plants.

During your secretary's official year he has prepared and mailed documents numbering 22,500 pieces and has received multiplied letters from all over the country and indeed applications for membership from other states not embraced in this Association, all of which indicates that the public looks to this organization as the most potent factor in the field, the healthiest, most vigorous, successful and beneficial independent telephone organization in America

President Raney: Gentlemen of the convention, the next thing in order on our programme will be the report of the treasurer. The secretary has suggested that these reports should embody dues that are being paid to them to-day or to-morrow at least, so we can not very well have a full and complete financial report. I wish to suggest to the convention the advisability of appointing an auditing committee to audit the accounts of these two officers, and then we can have a final report read at the close of the session or some time between now and adjourning. I suggest the question of an auditing committee at this time so it will not be overlooked.

Senator Hull: I move that an auditing committee of three be appointed by the chair to look over the books. Seconded and carried.

President Raney then called for the roll of the states, and requested that the representatives select one member for each state to serve on the committee on nominations. This was carried out as follows:

W. Guy Jones, Columbus, Ohio; Dr. H. S. Herr, Ottumwa, Iowa; W. F. Goodrich, La Crosse, Wis.; William Robinson, Muskegon, Mich.; L. A. Frazee, Connorsville, Ind.; Senator C. E. Hull, Salem, Ill.; W. F. Hall, Clinton, Mo.; H. K. Cole, Owensboro, Ky.; every state responding with the exception of Minnesota.

President Ranev then announced that invitations had been received to have photographs made of every one present, and also to inspect the tunnels which are being built for conduit purposes throughout the city. On motion, both of these invitations were accepted.

The question was raised by C. G. Cockerill, of Iowa, as to whether those independent exchanges which had made contracts with the Bell companies, either for the lease of instruments or the exchange of toll business, were eligible for membership in the association or entitled to be considered a *bona fide* exchange. During the discussion which followed, it developed that several exchanges had been offered toll service by the subsidiary Bell companies upon favorable terms, which terms did not bind them in any way beyond acting as agent for mutual exchange of business.

The convention, however, as a body did not look favorably upon this state of affairs, as every toll-line contract made with the Bell companies tended to discourage the building of independent toll lines. Upon the motion of B. F. Wasson, of Illinois, afterward amended by J. B. Ware, of Michigan, the question was referred to a committee of nine, one from each state, which was ordered to report Wednesday at one o'clock. The committee consisted of H. H. Robinson, Ohio; J. S. Bellamy, Iowa; W. J. Bell, Wisconsin; W. J. Buck, Minnesota; J. B. Ware, Michigan; M. Savage, Illinois; L. A. Frazee, Indiana; L. Tetu, Kentucky. While on this subject, the subject was raised as to whether men who are affiliated with the Bell companies are entitled to the association meetings. This question was also referred to a committee—Messrs. Cole, Kentucky; Rex, Indiana, and Conklin, Illinois.

The convention then adjourned to meet at one o'clock Wednesday.

WEDNESDAY'S PROCEEDINGS.

[*Special Telegram to the* ELECTRICAL REVIEW.]

Chicago, December 10—Owing to the fact that the committee on eligibility to membership was delayed in the preparation of its report, the convention was not called to order till 1.30 o'clock, President Raney in the chair. It was announced in opening that the attendance registered by some of the exhibitors was over 700 so far, and an appeal was made for all telephone men present to register their names at the secretary's headquarters.

The committee on eligibility to membership then made two separate reports to the convention. One was to the effect that the association pledge its members not to patronize supply houses selling material to new companies that are formed to compete with independent companies already in the field and giving satisfactory service. After considerable discussion, in which Messrs. Wasson, Ware, Frazee, Pruitt, Bellamy, Presson, Heimold and others participated, the resolution was adopted.

As to eligibility of membership, a question that produced considerable discussion on the preceding day, the report of the committee was to the effect that: As the success of the independent men depends upon their sticking together and assisting one another in every possible way, that manufacturers of independent apparatus had brought their apparatus to a high state of perfection owing to the fact that independent men had been compelled to purchase of them, and as toll line connections with the Bell companies would have a tendency to discourage the building of independent toll lines, that no one should be eligible to membership in the association who had any contract for toll or instrument connections with the Bell company unless in certain special cases where permission might be granted by two-thirds of the membership committee of their state, interstate or national association.

Discussion followed by Messrs. Slosser and Savage, of Illinois; Seebern and Tetu, of Kentucky, and others. Upon motion, the resolution was carried.

The reading of papers was then taken up, and a paper, "Rates—Measured Service," by George N. Bandy, of Perry, Iowa, was read.

Discussion: Mr. Conklin, Illinois—In the matter of measured service there are many items which make it difficult to apply measured service to all subscribers equally, and there are many conditions which have to be considered. In the first place, measured service was a plan by the Bell company to meet competition. In paying for measured service, the business places, being nearer to the telephone office and, therefore, having shorter lines, should receive a lower rate than residences, which are situated on the outer edges of the city and, therefore, entail a greater expense for maintenance. Under the flat rate all subscribers are treated alike, and, so far as the switchboard service is concerned, the expense of both business and residence connections is equal. Under the flat-rate system, the residence subscriber who uses his telephone but a few times a day pays a higher rate in proportion than the business man, who uses his telephone many times a day, and the higher maintenance account of a residence line is balanced by the fewer calls. Thus supposing, for example, that the residence subscriber pays ten cents a day for his telephone and uses it ten times each day, his rate would be one cent a call. A business man who uses his telephone thirty times a day at the same rate, pays only one-third of a cent a call. I merely suggest these

as points to be considered in the taking up of the question. I would say further that the flat rate is very popular.

The paper by Dr. H. S. Herr, of Ottumwa, Iowa, "Sliding Scale Rates for Exchanges," was read, in his absence, by his daughter, Miss Flora B. Herr, who received a vote of thanks.

Discussion: Mr. Glandon, of Illinois: I never heard of but one case where a sliding scale was adopted and that was in a small community in our state which began with a subscription list of less than fifty telephones. In this case the scale adopted was fifty cents for each subscriber till fifty-one telephones were in operation, when the rate was increased fifty cents, the increase gaining at the rate of fifty cents till a maximum of $2 was reached. The plan proved to be immensely popular, and the exchange, which started with fifty telephones, quickly ran up a subscription list of 200 or 300 subscribers, and, as the people understood the reason for the increased rate, they took a great interest in the increase of business. The rate seemed to appeal to them as a fair one, because they could understand that the more subscribers the system had the more valuable was their telephone service. Therefore, instead of trying to discourage new subscribers they endeavored to encourage them, which was different from what might have been expected.

The paper, "Toll Rates," by H. H. Robinson, Cleveland, was then read. Owing to time limitation further discussion of papers was omitted. At this time the secretary made the announcement that the membership fee of $5 being very low, every operator here present should be enrolled as a member.

The programme was here interrupted for a few minutes to allow Professor W. Elwell Goldsborough, chief of the Department of Electricity, Louisiana Purchase Exposition, to address the convention on the subject of supporting the electrical features of the approaching exposition. In his address he pointed out that the electrical building was near the centre of the grounds, and one of the most prominent of the buildings. That all of the leading features of the exposition had more or less connection with the electrical industry or art. That with the munificent appropriation of $50,000,000 by the United States, state and foreign governments, the exposition would be the greatest ever held. He also invited the convention to come to St. Louis during the exposition as a body.

This was seconded by a resolution offered by J. W. Layne, of Missouri, to the effect that the association meeting of 1904 should be held in St. Louis. In the discussion that followed it transpired that the St. Louis Exposition would close about December 1 of that year, while the constitution of the association required its meetings to be held after December 1. The matter was finally referred to a committee which was required to report upon the resolution and also introduce a motion removing this constitutional restriction for that particular occasion.

The next subject was a series of papers from members living in the nine states covered by the association on "Restrictions by Municipal Authority and Synopsis of the Law." There were nine names—one from each state—programmed to speak on this subject, but only three were on hand, *viz.:* W. F. Laubach, of Akron, Ohio; E. W. Pickhardt, of Huntingburg, Ind., and M. Savage, of Champaign, Ill., all of whom dwelt upon the legal rights and restrictions affecting telephone companies in their several states.

In the discussion following the reading of Mr. Savage's paper, Mr. Wasson explained that it was not by any means certain that the law giving telegraph companies the right of way on public highways was applicable to telephone companies, for which reason some of the companies operating in this state inserted the word telegraph in their corporate names, thus calling themselves telegraph and telephone companies, and that this was at least a useful precaution.

Mr. J. B. Ware, of Detroit, was down on the programme for a paper on this subject, but satisfied himself with a few brief notes regarding the laws of his state as follows:

In Michigan the public owns the highways, and any telephone or telegraph company receiving permission from the state authorities may occupy them without interference from anybody else.

Railroad crossings may be secured from the railroad commissioners under a permit.

As to trees, the telephone companies have the right to trim trees in a reasonable manner. In this connection we have the decision of the supreme court in a suit to restrain a company from setting poles on account of injury to trees, that, as the telephone companies were required to trim trees in a reasonable manner, they were subject to this restriction, and in the present case the company should be the best judge as to whether the proposed poles and the necessary trimming were reasonable or not, as much as intimating that this question could best be passed on after the work was done. The municipality has no right to force a rate upon companies as a condition of taking a franchise. No rate clause is necessary, but most of the independent companies have such a clause, thereby making the obtaining of a franchise somewhat easier, and adding to their popularity. The attorney for the Bell company claims that the city has no right to enforce such a clause, even if it should be in the franchise; but a recent decision by a court of another state holds that a contract taken voluntarily is as binding as a contract between individuals and must therefore be respected accordingly.

In Michigan we have a tax of three per cent on the gross receipts in lieu of all other taxes. This does not, however, apply to real estate held by telephone companies and used for telephone purposes.

If we desire to secure amendments to articles of an incorporation we can do so by paying the usual one-tenth of one per cent tax.

At this time the president announced the appointment of an auditing committee—Messrs. Frazee, of Indiana; Valentine, of Wisconsin, and Dobie, of Kentucky.

Mr. Wasson arose with the remark that many members would like information of various kinds on a great many subjects, and moved that a question box be a feature of the next meeting. This was carried.

Mr. Hutchinson, of Wisconsin, said the question of joint traffic rates between the companies was becoming a very acute one and moved the appointment of a committee of five to investigate and report a schedule of rates on toll service. Carried.

The committee was then appointed by the chair as follows: Messrs. Hutchinson, Wisconsin; Robinson, Ohio; Presson, Iowa; Layne, Missouri.

The convention then adjourned, and at the invitation of the Chicago Automatic Telephone Company visited the subways now being constructed for the use of the automatic telephone service.

THURSDAY'S PROCEEDINGS.

[*Special Telegram to the* ELECTRICAL REVIEW.]

Chicago, December 11 — President Raney called the convention to order at ten o'clock. The report of the committee appointed to act on the invitation tendered to the association by Professor

Goldsborough on behalf of the St. Louis Exposition was received as follows:

WHEREAS, the Interstate Independent Telephone Association appreciates the great opportunity that the St. Louis Exposition affords for giving the independent telephone movement desired prominence.

Resolved, That the association favors holding its annual convention in 1904 at St. Louis, at such time as the executive committee may determine. The association also commends the exposition to the support of independent manufacturers of telephone apparatus and supplies. Your committee also recommends that the constitution be amended as to time of meeting, so that the convention of 1904 may be held during the month of November.

The report was unanimously adopted as read.

The report of the auditing committee showed a cash balance of $240.

W. F. Hall, Clinton, Mo., urged that an organization of a general committee for standard construction for city and toll-line work be effected. He also spoke of the importance of a general committee to take up the question of competition among independent companies in the same territory.

A. L. Hutchinson, of Weyauwega, Wis., then read his paper on "Settlement of Toll Business Between Connecting Companies." The ultimate success of any enterprise, he said, depends on the ability of its management to do business at profitable prices and to collect the full compensation when earned. It is very necessary for a telephone company, under present-day conditions, to be absolutely sure that every penny earned by it is charged to the proper source and duly collected. The transaction of business between connecting telephone companies is without a parallel. A system for taking care of the business of connecting telephone companies is demanded which will fill the requirements of having a uniform method of ascertaining the rate between any two points, a uniform method of dividing the fees received among the connecting companies. To make this possible, it follows that there must be at least one central office in each state for the careful checking and apportioning of payment among the several companies involved in the transmission of the spoken message. The central office should be a clearing office in the true sense of the name. All joint messages should be reported to it. The clearing office must open an account for every station with every other station to which a message has been transmitted. At the end of the month the separate station accounts must be brought together, and all companies having business with each other must be included in a single statement. The clearing company should be a company distinct in itself, and it should not be a mutual affair. The clearing house should handle no funds, but it should draw drafts against debtor companies for such amounts and payable to such companies as shown by the statements to be due, and such drafts should be honored and paid by the company against which the same are made.

The next paper was by H. E. Ralston, of Maitland, Mo., on "Enforcement of Message Time Limit," followed by a paper on "Independent Telephone Securities as an Investment," "From a Banker's Standpoint," by Colonel J. D. Powers, of Louisville, Ky., and "From a Small Investor's Standpoint," by J. W. Layne, of Carthage, Mo.

J. J. Nate then read a paper on "The Telephone Transmitter, Its Early History, Its Present Status with Relation to the Berliner Patent." This paper was announced as "The Berliner Patent, Bell's Claims of Infringement, and Litigation Now Pending."

The last paper was on "Suggested Methods for Improving Long-Distance Telephony," by Senator C. E. Hull, Salem, Ill.

The committee on nominations then reported and officers for the coming year were elected as follows:

President, Charles E. Hull, Salem, Ill.

Vice-president, L. A. Frazee, Connorsville, Ind.

Secretary, E. M. Coleman, Louisville, Ky.

Treasurer, J. W. Layne, Carthage, Mo.

Executive committee—Ohio, W. Guy Jones, Columbus; Iowa, H. S. Herr, Ottumwa; Wisconsin, A. L. Hutchinson, Weyauwega; Minnesota, E. H. Moulton, Minneapolis; Michigan, J. B. Ware, Detroit; Indiana, O. Rex, Manchester; Illinois, A. B. Conklin, Joliet; Missouri, W. F. Hall, Clinton; Kentucky, David Pruitt, Winchester.

R. B. Watrous, of Milwaukee, Wis., extended an invitation to the association to hold its next convention in Milwaukee. The delegates voted to leave the date and place of meeting at the discretion of the executive committee.

The convention then voted its thanks to the city and manufacturers of Chicago for the elaborate entertainment which had been tendered them, after which it adjourned.

At the banquet in the evening the following speakers were heard: Representative of states—Illinois, Charles B. Cheadle, Joliet; Indiana, A. L. Frazee, Connersville; Iowa, J. S. Bellamy, Knoxville; Kentucky, Colonel J. D. Powers, Louisville; Missouri, J. W. Layne, Carthage; Wisconsin, Richard Valentine, Janesville; Ohio, H. H. Robinson, Cleveland.

Representatives of supply houses—J. A. Bennett and Charles E. Brown.

Representatives of manufacturers—J. J. Nate, F. W. Pringle, F. G. Jones, J. McHugh.

Representative of cedar pole men—E. A. Lindsley.

Representatives of electrical journalism—H. B. McMeal, W. H. McDonough.

Telephone Manufacturers at the Interstate Convention.

An Engineer's Comment on Telephone Apparatus Shown—Manufacturing and Commercial Interests Represented.

NEVER in the history of the telephone industry has there been such a large attendance on the part of the manufacturers at any telephone convention in the West. Many of the largest manufacturers of wires and cables and kindred supplies used in the telephone industry were also in evidence, and a large number of the electrical supply houses showed the greatest interest in the meeting, to the extent of having from one to a dozen representatives present.

Over fifty manufacturers of telephone apparatus and makers of special equipments used in telephone engineering exhibited their products in the parlors and private rooms of the Auditorium Hotel. In many instances, the exhibits represented a considerable effort and expense, as the large manufacturers had on view complete lines of standard telephone instruments, switchboards, receivers, transmitters and all characteristic of telephone appurtenances.

"With the exception of slight improvement in construction and design, this apparatus," remarked a critical "Bell" telephone engineer, "shows but little general modification of the telephone equipment offered to independent telephone ex-

changes twelve months ago. The excellent switchboard work now being seen in Chicago is a credit to these manufacturers." This seems to be a good criticism and an indication that the product of the telephone manufacturers is reaching a point of ultimate standardization, and also a high degree of perfection.

A partial list of the prominent manufacturing interests represented and their personnel follows, as telegraphed to the ELECTRICAL REVIEW by its Chicago correspondent:

Chicago Telephone Supply Company, Elkhart, Ind. George A. Briggs, president; S. A. Duvall and L. E. Bourveau.

North Electric Company, Cleveland, Ohio. C. H. North, president; George C. Steele, secretary and treasurer; F. F. Sapp, advertising and sales manager; L. G. Bowman, sales department; H. L. Knight, superintendent; J. F. Davis, engineering department; George B. Pratt, sales department.

American Electric Fuse Company, Chicago, Ill. F. G. Jones, president; J. A. Kenney, manager; C. A. Rolfe and G. W. Rodomer.

Swedish-American Telephone Manufacturing Company, Chicago, Ill. E. B. Overshiner, president; A. V. Overshiner, C. H. Macklin, R. L. Scott and F. M. Ferguson.

Farr Telephone and Construction Supply Company, Chicago, Ill. C. W. Farr, president; E. W. Hurst, general manager, and J. E. Bowen.

Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill., and Rochester, N. Y. J. J. Nate, William Bowen, R. B. Tyler, E. C. Lewis, E. L. Brown, A. B. Smith, H. B. Hewitt, Paul D. Myers, J. A. Carr, A. S. Munsell, W. T. Heddon, A. J. Rousseau and F. L. Martin.

Standard Vitrified Conduit Company, New York. B. S. Barnard.

The Calculagraph Company, New York. Henry S. Abbott.

Western Telephone Manufacturing Company, Chicago and Winthrop Harbor, Ill. F. W. Prindle, vice-president; J. E. Keelyn, sales manager; H. S. Prindle, superintendent; W. G. Peacock, John Winnie, Charles Saunders.

American Telephone and Electric Company, Chicago, Ill. P. C. Burns, president; J. G. Ihmsen, general manager; H. C. Dodge, S. J. Baer, H. P. Clausen, superintendent, and a staff from the sales and engineering departments.

Standard Pole and Tie Company, New York. Fred L. Merritt, secretary and treasurer, and W. E. Mitchell.

Yonkers Specialty Company, Yonkers, N. Y. F. C. Fuller.

W. S. Nagle Electric Company, Toledo, Ohio. Harry Edwin Adams.

Mountain State Electrical Company, Wheeling, W. Va. Frank B. Hall, A. F. Poole.

National Carbon Company, Cleveland, Ohio. M. H. Moffitt and A. V. Ward.

National Automatic Telephone Company, Chicago. E. E. Salisbury.

Eureka Electric Company, Chicago, Ill. I. J. Kusel, H. J. Kusel, B. L. Canmann, H. J. Robbins.

John A. Roebling's Sons Company. W. P. Bowman, Cleveland manager; A. B. Conover, Chicago manager; R. M. Abbott, W. S. Slingoff, P. C. Griffin.

Varney Electrical Supply Company, Indianapolis, Ind. A. A. Marsh.

Holtzer-Cabot Electrical Company, Boston, Mass. C. W. Holtzer, E. R. Harding, Thomas Meinema, A. E. Klunder, F. D. Hodgson.

Williams-Abbott Electric Company, Cleveland, Ohio. L. Sands, president.

McDermid Manufacturing Company, Chicago, Ill. C. L. Barlingham.

Maltby Lumber Company, Bay City, Mich. I. A. Maltby, A. Maltby.

Gordon Battery Company, New York. M. Deems, western agent.

Standard Telephone and Electric Company, Madison, Wis. J. H. Parish.

The Couch & Seeley Company, Boston. E. B. Seeley.

The Electric Storage Battery Company. Charles Blizzard, general manager, Philadelphia, and Godfrey H. Atkin, manager Chicago office.

Automatic Electric Company, Chicago. S. A. Harris and J. F. Crook.

Kellogg Switchboard and Supply Company, Chicago. R. L. Ames, A. E. Barker, C. P. Belden, W. W. Dean, W. L. De Wolf, F. M. Dunbar, J. B. Edwards, S. Guthrie, L. D. Kellogg, H. Krause, D. D. Mackay, R. H. Manson, K. B. Miller, C. F. Reynolds, C. A. Simpson, William J. Gunn.

W. J. Barr, Cleveland.

Hipwell Manufacturing Company, Pittsburg and Chicago. H. H. Hipwell, Pittsburg; J. A. Russell, Chicago manager.

International Telephone Manufacturing Company, Chicago. Henry Shafer, president; W. E. McCormick, vice-president; John C. Burmeister, secretary; R. N. Stites, treasurer; D. A. Clithro, attorney; D. L. Berry, sales agent.

The Okonite Company, Limited, New York. George T. Manson, general superintendent, and staff of representatives from Central Electric Company, the Chicago agent for this company.

American Carbon and Battery Company, St. Louis. Henry Wrape and P. P. Gleason.

H. B. Camp Company, New York, Chicago and Aultman, Ohio. J. A. Hammett, W. W. Montgomery.

E. E. Nangle Tie Company, Chicago. E. E. Nangle, A. T. Nangle.

Illinois Electrical Specialty Company, Chicago. F. B. Patton, H. V. Rugh, J. W. Lyman.

W. H. Anderson & Sons, Detroit. W. R. Anderson, secretary and treasurer.

Central Telephone and Electric Company, St. Louis. James S. Cuming, president; C. H. Wallis, J. J. Joys.

Controller Company of America, St. Louis. George L. Moselle.

F. Bissell & Company, Toledo. F. Bissell, president; C. M. Hamilton, W. S. Bissell, M. S. Walker.

Electrose Manufacturing Company, Brooklyn. Joseph Steinberger, vice-president; H. E. Cobb, Chicago manager.

Edison Decorative and Miniature Lamp Department of General Electric Company, John I. Solomon.

New Haven Novelty Machine Works, New Haven. H. Grant Thompson, president; Charles Luke Luption.

H. Lindsley Brothers' Company, Chicago. G. L. Lindsley, president; C. P. Lindsley, vice-president; E. A. Lindsley, secretary and treasurer; Alexander Navarre, assistant manager.

Standard Underground Cable Company, Pittsburg, New York and Chicago. J. R. Wiley, Chicago, manager; E. J. Pietzker, assistant superintendent; P. H. Smith, assistant general manager; A. A. Anderson, cable expert.

Sterling Electric Company, La Fayette, Ind. W. E. Doolittle, president; F. E. Rotchka, general manager; S. B. Fowler, electrical engineer; H. A. Taylor, vice-president and secretary; E. Van Shelby, G. W. Metcalf, E. M. Johnson, H. T. Doolittle, purchasing agent.

Nungesser Electric Company, Chicago. F. Greer.

Nungesser Electric Battery Company, Cleveland. Thomas G. Grier, western manager; H. G. Robbins, G. S. Jenkins.

Allen-Hussey Interior Telephone Company, Chicago. Frank Heffron.

Veeder Manufacturing Company, Hartford, Ct. E. G. Biddle.

H. Wotton Electric Manufacturing Company. Thomas H. Grier.

Vought-Berger Company, La Crosse, Wis. M. I. Berger, secretary and treasurer.

Electric Appliance Company, Chicago, Ill. W. W. Low, president; S. A. Dinsmore, E. C. Brown, F. D. Phillips, J. B. McMullen, S. A. Rall, G. A. Kimmell.

Warner Electric Company, Muncie, Ind. Represented to the office of the Electric Appliance Company.

Gray Pay Telephone Company, New York. E. B. Baker.

New York Insulated Wire Company, New York and Chicago. James Wolff, manager Chicago office.

Central Electric Company, Chicago. George A. McKinlock, Charles E. Brown, and staff from sales department.

Warner Electric Company, Muncie, Ind. T. W. Warner, president.

Frank B. Cook, Chicago, and James Cook.

American Toll Telephone Company, Chicago. G. H. Morgenstern, manager sales department.

American Steel and Wire Company, Chicago. H. H. Sheppard and George Chandler.

Gould Storage Battery Company, New York and Chicago. A. C. Gallagher.

Valentine-Clark Company, Chicago. Messrs. Valentine and Clark.

Chicago Pay Station Company, Chicago. J. C. Finch.

Haines & Noyes Company, Chicago. J. A. Haines, president.

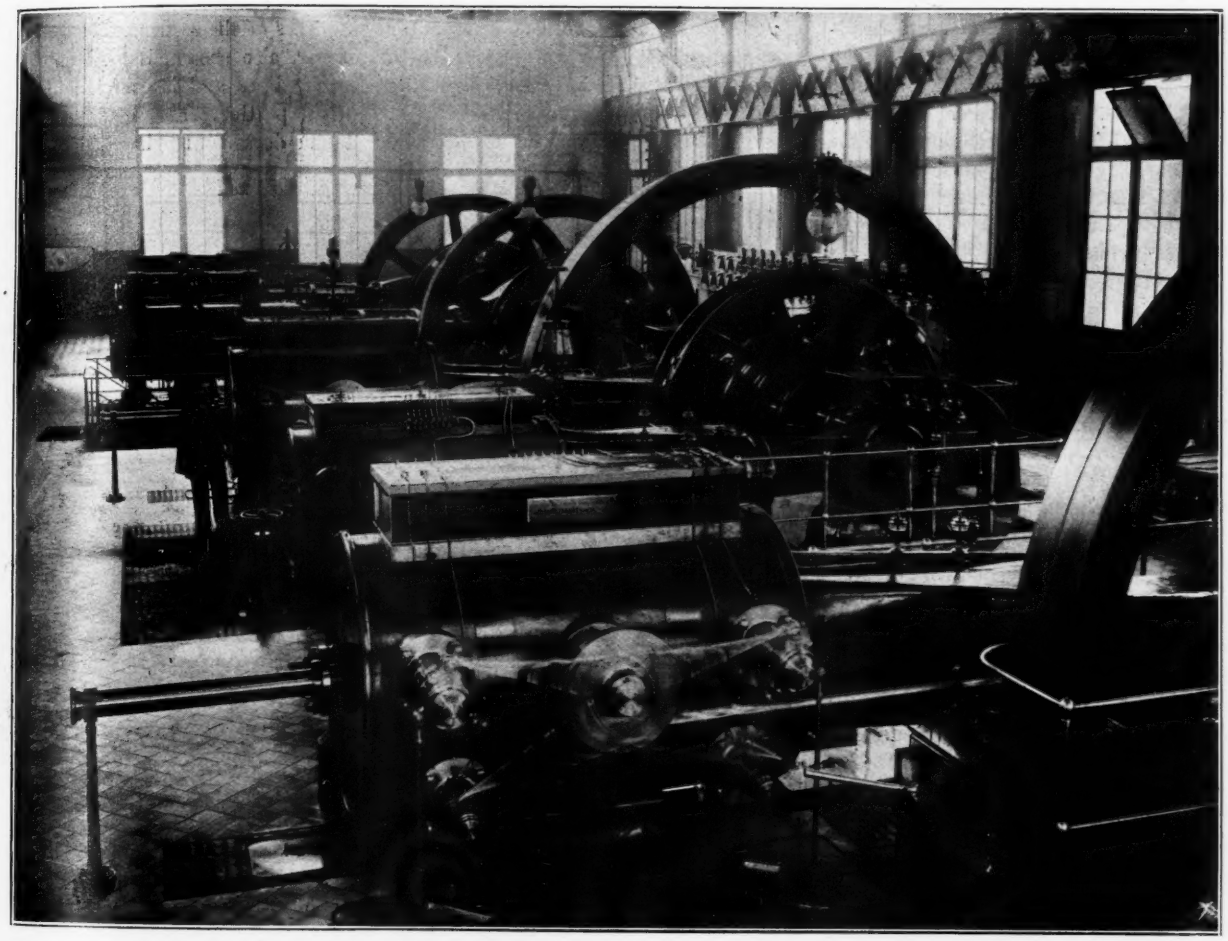
McRoy Clay Works. E. F. Kirkpatrick, Chicago manager.

The Nogentais System, Paris, France.

A Description of an Interurban Traction System, Radiating from the French Capital.

By C. L. Durand.

ONE of the largest of the Paris traction systems is that which has been lately installed to supply a part of the eastern suburbs, and known as the Nogentais system. The existing lines branch out from Paris in several directions and cover a total length of thirty miles. A part of these lines was formerly operated by a compressed-air system, but it was decided some time ago to abandon this method and substitute electric traction, while at the same time a number of new concessions were secured. As now operated, a main trunk line starts from the city terminus at the Place de la Republique and serves to supply the different suburban lines which branch from it just outside the city limits. The latter pass through different suburban centres which have a large population. The system, which has been installed by the Thomson-Houston Company, is not only a large one, but is of interest on account of the different varieties of traction which are employed. From the city end, accumulator traction is used for a short distance, then comes an underground conduit which leads to the Vincennes Gate. From this point commences the suburban system which uses the trolley line for the different branches. To carry out this arrangement two types of cars are used; the first of these is equipped for accumulator, conduit and trolley, and takes passengers from the city terminus to the suburban points. The second type of car uses the trolley system alone, starting from the Vincennes Gate, where it connects with the eastern terminus of the Metropolitan, and circulating through the suburbs.



THE GENERATING STATION OF THE NOGENTAIS SYSTEM, VINCENNES.

The generating station which supplies the whole system is located in the suburbs of Vincennes, just outside the city limits, and near the main tramway line. A track runs from the station to the river bank so as to obtain the coal supply in the most convenient manner. The coal is unloaded from the boats and stored in a large supply yard, from which it is hauled to the station by special cars. The boiler room, which is on the ground floor of the station, contains eight boilers, grouped in two sets. Each of these boilers, which has a total heating surface of 120 square yards, can furnish 5,000 pounds of steam per hour, corresponding to a total of about 2,500 horse-power. The boilers use city water, which is passed through a Desrumeaux filtering apparatus and is stored in two reservoirs of 100 cubic yards capacity. To avoid any accidental stoppage of water, owing to a cutting off of the city supply, a well of 300 feet has been sunk on the premises. Two steam pumps, each having a capacity of 4,000

gallons per hour, send the water into the feeding reservoir, which is situated below the ground level, and from there sends it to the boilers. The station also contains an apparatus which furnishes distilled water for the accumulators of the cars. The distilling outfit is mounted on a platform about ten feet from the floor, and the distilled water is thus sent by pressure through lead piping to a reservoir in the battery room, and from there it passes to supply plugs located in the different inspection pits.

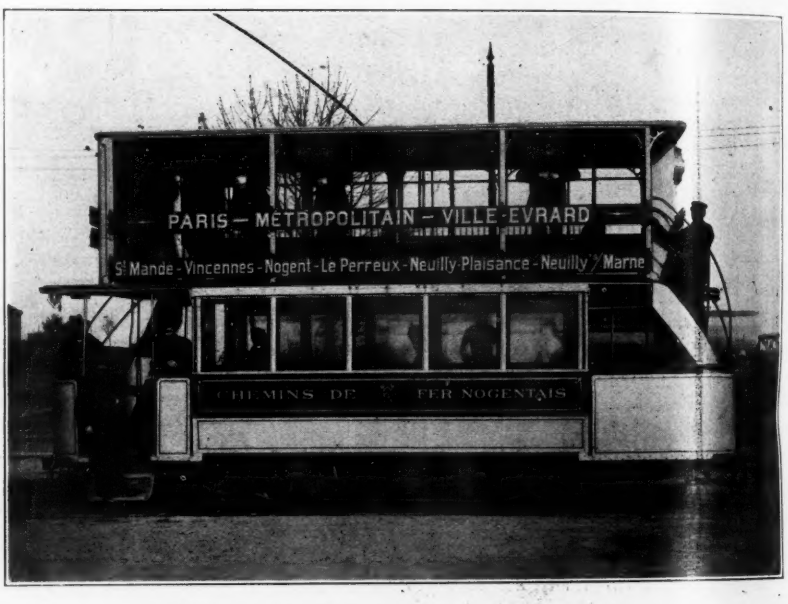
The dynamo room, of which a general view is seen in the engraving, is in the second story, and contains four direct-connected generating sets, two of which are of 500 kilowatts and the other pair 325 kilowatts. The former have each a horizontal-compound engine of the Farcot type, giving 750 to 1,000 horse-power at ninety-five revolutions per minute. The smaller sets have single-cylinder engines of 450-600 horse-power and ninety revolutions. The flywheels, weighing twenty-five tons for the large groups and twenty tons for the smaller, are placed outside of the dynamos and between the two bearings. The current is used to feed the trolley lines and the portion in underground conduit, and besides drives the motors which operate the pumps at the station; it also supplies the lighting circuits for the station and the various depots along the line, besides operating a motor in the repair shops and charging the accumulators of the cars. The four generators above mentioned are of the Thomson-Houston multipolar type, and are over-compounded so as to give a tension of 500 volts at no load and 600 volts at full load. The station also contains a motor-generator set used to supply the underground conduit sections. It has a fifteen-kilowatt motor direct-coupled to a six-pole generator of 500 volts and 150 kilowatts capacity. There is besides a booster set which is made up of a fifteen-kilowatt motor direct-connected to three generators. The armatures of the latter are traversed respectively by the current of each of the return feeders. Under these conditions the electromotive force developed in each of the three generators is equal and opposite to the fall of potential in the corresponding feeder, so that the potential at the extremity of the feeder is constantly equal to that of the negative bar, which is an essential condition for reducing the effects of electrolysis.

From the generating station leads an extensive system of feeders which lies underground throughout its entire length, supplying the line at a great number of points. The system includes twelve miles of positive cable and three miles of negative. These cables have a large copper section, from 300 to 400 square millimetres, and are well insulated and lead-covered. The overhead trolley line, formed of two copper wires of nine millimetres in diameter, are suspended upon double insulators at a height of twenty-two feet above the track. The system is divided into sections of about 4,500 feet length, which are united at the extremities by section insulators. The sections of trolley line are connected together by insulated cables which are provided with a switch. Each section has a lightning arrester of the magnetic blow-out type. The posts which support the trolley wire are of drawn steel tube and carry brackets of handsome design; these posts are fixed in the ground in a beton foundation about six feet deep. The heavier rails of the track, weighing forty-eight kilogrammes per metre, are connected by Falk joints and the lighter rails of twenty-five kilogrammes, by double rail bonds.

The penetration line which passes into the city is in underground conduit for the most part, covering a distance of 1.8 miles. A short section of track leads from the end of the conduit to the terminus at the Place de la Republique, and on this part the traction is carried out by accumulators. The underground conduit is of the same general type as that which is now in successful operation on the Bastile-Montparnasse tramway system of Paris, and also on the St. Ouen-Champ de Mars line which leads from the city to the suburbs. In the present case the lateral type of conduit is used. The track is double and the conduits are placed side by side underneath the inner rail of each track.

The motor cars used on this line present some interesting features, especially the car which is designed to run within the city limits. The appearance of this car will be noticed in the engraving. It is used for three different methods of traction, namely, overhead trolley, underground conduit and accumulator, and these cars can therefore circulate over all the lines of the system. The second form of car, also shown, is used only for the trolley lines and is confined to the suburban portion. The first type of car is double-decked and has thirty-four feet total length. These cars contain seventy-eight places in all, divided into first and second class, as is usual on the Paris tramways. The first class has twenty-six places seated in the interior; the second class has thirty-six places seated on top and sixteen standing on the front and rear platforms below. The interior compartment is separated from the platforms by sliding doors, and the staircases are divided off by a partition which in the rear separates the passengers mounting the staircase from those entering the car, and in front affords a place for the motorman. The upper deck is open in summer, but is closed in winter by removable glass windows. This latter feature is an innovation over the usual Paris systems, and is greatly appreciated by the public.

The car-body is supported on two

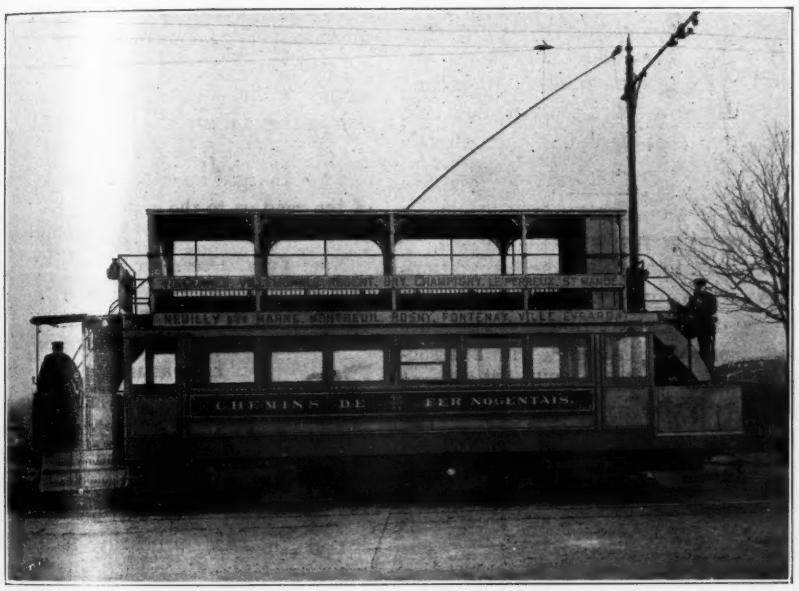

PARIS — METROPOLITAIN — VILLE-EVRARD
St Mande - Vincennes - Nogent - Le Perreux - Neuilly-Plaisance - Neuilly / Marne
CHEMINS DE FER NOGENTAIS

TROLLEY CAR, NOGENTAIS SYSTEM, PARIS, FRANCE.

double-axle trucks, measuring four feet between axles. The space of twelve feet between the trucks gives room for the accumulator box. On each truck is mounted a forty-five-horse-power motor of the T.-H.-2 type, driving the axle by gearing. The motors are connected to the controllers placed as usual on the front and rear platforms. An air compressor is operated from the main axle and supplies the brake system. As these cars are obliged to go a certain distance by the aid of accumulators alone, they are provided with a battery of the Union type composed of 210 elements of forty pounds each. These are distributed in six cases and lodged in the box which is supported between the trucks upon sliding rails. The current needed for charging the batteries is taken en route from the trolley line, and the duration of the charge does not exceed nineteen minutes. The cars are also supplied with the contact plows which are required for the underground conduit. At the end of the conduit line the plow is raised through a manhole and the car proceeds by the accumulators alone. The cars are used with or without a trailer; in the latter case, with a train of twenty-two tons, the electric equipment is sufficient to give a speed of fourteen miles an hour on level track.

The second type of car noticed in the photograph is of a lighter build. It has a double-axle truck, each carrying a G.-E.-58 motor giving thirty-five horse-power. The arrangement of double deck and staircases will be noticed. This car uses the trolley alone and is confined to the suburban system, connecting with the Metropolitan just outside the Vincennes Gate. The rolling stock includes the necessary trailers which are used with both types of car, these being put on at times of heavy traffic. The total number of cars in use include forty of the larger, fifty-one of the smaller and thirty trailers, making a total of 121 cars. Electric heaters are provided, these being placed at the floor level under the seats.

The main car barn, located at the Maltournee station, has tracks and inspection pits for ninety cars. This station includes a repair shop, and is also provided with an equalizing storage battery used for this part of the line containing 220 cells of the Union type, having a capacity of 400 to 600 ampere-hours. The battery affords a constant tension of 450 volts in this part of the system, which is more than five miles from the generating station. The curves show the variation of voltage on the trolley line at this point, with and without the equalizing battery. The curves were taken during a period of fifteen minutes on the trolley line in front of the station. The battery is charged by a booster composed of two generators of the C-8 type coupled together. The boosting dynamo, separately excited, is branched on the trolley line and has a capacity of 150 amperes, while its voltage can vary from 0 to 100 volts.



CAR USING BATTERIES, CONDUIT AND TROLLEY, NOGENTAIS SYSTEM, PARIS, FRANCE.

Rule for finding the required quantity of air for the complete combustion of one pound of coal of a given composition: Let the constituent carbon, hydrogen and oxygen be expressed as percentages of the total weight of the coal. To the carbon add three times the hydrogen, and from the sum deduct four-tenths of the oxygen. Multiply the remainder by 1.52. The product is the quantity of air at sixty-two degrees Fahrenheit in cubic feet required.

American Roentgen Ray Society.

The annual two days' convention of the American Rœntgen Ray Society began at the Sherman House, Chicago, December 10. Delegates to the number of 200 were present, and several hundred more physicians and specialists in the study of X-rays from throughout the United States and Canada. The following papers were on the programme for reading and discussion: "X-Ray Physics," by T. Proctor Hall, Chicago; "Equal Potential Surfaces in X-Ray Fields, Their Production and Utilization," by John C. Pitkin, M. D., Buffalo; "Instantaneous Skiagraphy," by Mihran R. Cassabian, M. D., Philadelphia. These papers were read at the Wednesday morning session, beginning at 10 A. M.

The Wednesday afternoon session was opened at 2.30 P. M. by the president's address, followed by the reading of a paper on "Systematic Records and the Routine Use of X-Rays," by M. J. Wilbert. The next paper was "Skiagraphy as an Art," by J. Rudiz Gicinsky, Cedar Rapids, Iowa. A paper on "Results and Technique in Treating Epithelioma with X-Rays," by Emil H. Gruber, Chicago, was also read.

The session on Wednesday, at 8 P. M., began with the reading of a paper on "The Treatment of Three Cases of Cancer, One Case of Tuberculosis, Seven Cases of Rodent Ulcer and Lupus," by G. P. Girdwood, Montreal, Canada. The following papers were then read: "The Rœntgen Ray as a Therapeutic Force, from a Clinical Standpoint, with Illustrative Cases," John B. Murphy, Chicago; "The Technique of Treatment of Malignant Growths," J. N. Scott, M. D., Kansas City, Mo.; "The Technique of X-Ray Therapy," H. Preston Pratt, M. D., Chicago; "Radiotherapy in Pulmonary Tuberculosis," Gordon G. Burdick, M. D.; "X-Ray Treatment in Intra-Abdominal and other Deeply Located Malignant Growths," Clarence E. Skinner, M. D., New Haven, Ct.; "Diagnosis of Calculi by X-Rays." Russell H. Boggs, Pittsburg.

At the Thursday afternoon session, at 2.30 P. M., the following papers were read: "Result of Treatment of Guinea Pigs Affected with Tuberculosis by High-Frequency Currents," G. P. Girdwood, M. D., and C. Higgins, D. V. S., Montreal, Canada.

The officers of the American Rœntgen Ray Society are: G. P. Girdwood, M. D., president; Dr. James B. Bullitt, Louisville, secretary; Dr. E. A. Florentine, Saginaw, treasurer; Drs. John B. Murphy and Arthur W. Goodspeed, vice-presidents.

CORRESPONDENCE.

Low-Frequency Alternating-Current Systems.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In the recent development of single-phase railway engineering, one of the difficulties encountered was the lighting (by incandescent lamps) of the cars and premises, supplied by the low-frequency system employed in the motor operation. This difficulty, according to Mr. B. G. Lamme, in a recently delivered paper, was overcome after considerable experimental work by the use of short, thick filament incandescent lamps, and the operation of the same at a comparatively low voltage. Even now the actual use of such a method on the particular railway system referred to seems to be somewhat in the future.

The continued commercial use of such a low-frequency system, however, is a matter of record, and it may be quite interesting to note that such a system as Mr. Lamme now refers to as successful (when promoted by certain interests) was about two years ago characterized by representatives of the same interest as laughably absurd, even though an equipment of about 600 kilowatts arranged by the writer for the Narrangansett Electric Lighting Company, of Providence, R. I., was in operation at that time. The installation above referred to, operated at fifteen cycles, continues in daily satisfactory use, and if I am not mistaken is the first, if not the only, system of its character operated commercially in this country.

WILLIAM CARPENTER WOODWARD.

Providence, R. I., December 2.

Heating of the Brooklyn Trolley Cars.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

During a tie-up of one of the Brooklyn trolley roads on Monday, December 8, the conductor of one of the cars was heard to call to the motorman, as he rang his bell twice, "Why don't you go ahead?" The reply came, "How can I go ahead when I ain't got no ice water?"

Taking this conversation in connection with the long delay which followed, the writer came to the conclusion that the motorman meant to inform the conductor that the electricity had been shut off from the power-house for some reason, and as a consequence he could not start his car.

Knowing that electricity is supposed to be used for heating these cars, it occurred to the writer that possibly the Brooklyn company was using a new brand of electricity which the motorman designated by "ice water," and the question then presented itself, "would this account for the present miserable system of heating these cars?" In other words, is the kind of electricity by which this company is now operating its cars not as suitable for heating as that in use in other places? If you can clear up this question, and should it appear that there are other advantages derived from the use of this kind of electricity, this knowledge will help the writer materially in bearing philosophically the discomforts due to its use in very cold weather.

ONE WHO SUFFERS.

Brooklyn, December 10.

[There is no one kind of electricity that is more suitable for heating cars than others. The amount of heat given off in a car depends simply on the power used for this purpose, so that any car can be made comfortable if suitable heaters are installed. The system used in propelling the trolley cars of Brooklyn does not differ from that used on other electric roads.—ED.]

Blockade on the Elevated Roads.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

It is unfortunate that those conditions which make us most dependent upon our systems of transportation are the ones which most often interfere with the successful operation of these. Thus, the recent sharp sleet-storm not only made it very difficult to get about on the streets of the city, but tied up, as well, several of the elevated roads—steam as well as electric.

Having this danger in mind, the railway engineer provides all means of preventing such mishaps as occurred on these lines. The Manhattan cars are supplied with pneumatically operated track scrapers, which can be lowered or raised by the motorman at will. The company has ten equipments of oil and salt water spraying machines on each line. This would seem to be ample provision for meeting any conditions of weather, yet two of the electric lines were tied up.

Just why this happened I have not heard, but it would seem to be due to lack of organization among those who are responsible for the proper movement of the cars. The engineers have spared no effort to prevent such delays, and by telephoning from point to point, within a few minutes the superintendent could have put in operation all of the scrapers and spraying apparatus to clear the conducting rail and enable the cars to make fair schedule time.

It should be remembered by the railway company that its new system is being watched very closely by many railway interests, some of which will be only too willing to use this opportunity for unfavorable criticism. It is well known that the elevated roads in Chicago and Boston have been operating successfully for some years under conditions every bit as trying as were those during the recent storm; but it is always difficult to regain the loss of confidence due to any failure, however small.

Furthermore, in a city situated as New York, far more depends upon the railway systems than would be the case were approach to the business section of the city more easy. As it is, there are but five roads leading from the main residence sections of the city to the business part, certainly a small number upon which to be entirely dependent. Under these conditions one would naturally assume that the managers of the road were ready for all contingencies, and the fact that sleet-storms are not unusual at this time of the year makes failure the less excusable.

Let the blame be put where it is due, and not charged up either to the engineers of the road or to the system.

AN ENGINEER.

New York, December 9.

Subject-Matter Index of Mining, Mechanical and Metallurgical Literature.

This index covers the year 1900, and was compiled by the North of England Institute of Mining and Mechanical Engineers, and edited by Mr. M. W. Brown, the secretary. Although the index is intended primarily for mining engineers, it covers practically the entire field of applied science. Articles are indexed by title and author only, no abstract being given. One section of the index is devoted to electrical machinery and stations. The list of journals indexed is very complete, there being about 450 in all.

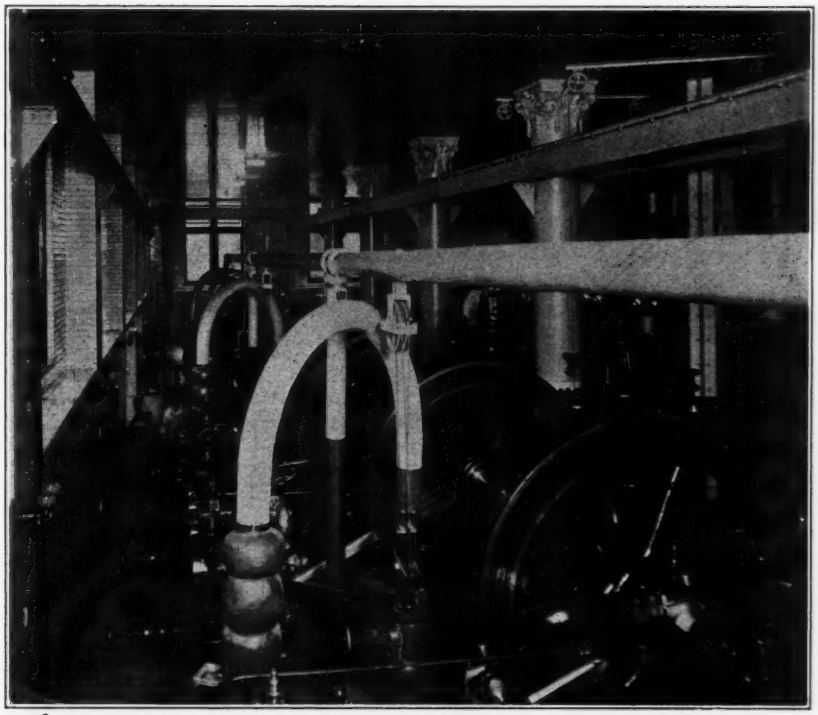
Local Meeting of the American Institute of Electrical Engineers.

A local section of the American Institute of Electrical Engineers has been organized at the University of Illinois, the first meeting being held the twenty-fifth of November. There were present at this meeting the instructors and senior students of electrical engineering, and the papers presented at the October and November meetings of the society were read and discussed. It is expected that at future meetings—which are to be held monthly—students in other engineering departments will be present.

The Equipment of the Mechanical Department of the Prudential Insurance Company of America, at Newark, N. J.

THE Prudential Insurance Company of America occupies five office buildings in the city of Newark, N. J., as its headquarters and home offices—the Prudential Building and Prudential Main, West, North, and Northwest buildings. The architecture of these buildings is on a scale of magnificence and completeness which is approached by a conception of only the most modern ideas in construction work. The mechanical plant, both as regards efficiency and design, is very elaborate, and neither expense nor pains have been spared in bringing it to a highly finished state. This mechanical plant supplies the power for the different buildings, which are twelve stories high, having approximately thirteen acres of floor space. The chief requirements met by the plant are lighting, heating, elevator service and refrigerated water supply. All of the main floor of what is designated as the North Building, except the space required for the main hall, is occupied by the mechanical plant. This consists of an engine room which is in the building proper, and a boiler house which is practically an addition to the building on the northerly side. The floor of the engine room is some distance below the street level, and the room extends to the ground-story ceiling. The room is about 45 by 111 feet in plan, and all of the apparatus is set so that a fine view is obtained from the street. The windows look into this room from two sides of the building, and are very high and set pivotally so that they may be swung in, affording a very clear view of the mechanical apparatus. All of the piping for the plant, as far as it is possible, is carried beneath the floor of the engine room in order to obviate all auxiliary connection which might be unsightly.

The electrical equipment of this plant is very complete, and the electrical features contained in the different buildings are very extensive and operate under singularly good conditions. The electrical apparatus in the engine room consists of four Bullock dynamos, direct-coupled with Ball & Wood tandem-compound engines. Three of the electrical units are of 250 kilowatts capacity each, the engines being seventeen and thirty by eighteen inches in cylinder dimensions, and the fourth is of 150 kilowatts capacity, with a twelve and twenty-two by sixteen-inch engine. The switchboard consists of nine panels of marble, seven and one-half feet high, the total length being some thirty-six feet. Eight of the panels are devoted to the electrical registering instruments and to the different circuit-breakers and controlling apparatus, the end panel being devoted to the steam and hydraulic pressure gauges. Adjoining the engine room, a long vault has been built underneath the street, this containing the storage battery outfit which is used during the night to carry the load for the different buildings.



THE ENGINE ROOM FROM THE GALLERY, PUMPING ENGINES IN THE FOREGROUND, PRUDENTIAL INSURANCE COMPANY, NEWARK, N. J.

All of the electrical apparatus in the different buildings is operated on 125-volt, direct-current circuits. There are approximately 20,000 incandescent lamps in use, 600 of these being used on the tower for spectacular illumination. The Sterling "Special" lamp is used very generally throughout the different buildings. Besides the current used for lighting, there are about seventy motors throughout the buildings, ranging from one to fifty horse-power. The book-bindery and printing establishment occupies very nearly all of one large building, and all of the printing machinery is direct-driven from electric motors, ranging from one to twenty-five horse-power in size.

The telephone service requires four operators, there being 400 private intercommunicating telephones in the various buildings. The annunciator system at the present time has in operation about 3,500 drops. This will shortly be increased to 4,000. The annunciator and telephone system of these buildings is thought to be one of the most complete that has ever been installed.

Every room in the Prudential Building has five pairs of wires for telephones, messenger calls, Western Union, private fire-alarm calls and clock wires. This building is lighted from chandeliers, all side fixtures being eliminated. All desk lighting is accomplished with Zimdars & Hunt flush base plugs. Thus, instead of having side fixtures of any description, a flexible cord is run from the desk light to the flush base plugs, these being used wherever desirable. This system of wiring will be inaugurated in each of the buildings, so

that the entire equipment will be of one character.

An elaborate card system has been established for this building, which will also be carried out throughout the entire series of buildings, and which is under the personal direction of Mr. Frank A. Heimbold, the electrical engineer of the Prudential company. Mr. Heimbold has been with this company since nine years ago, when with a single forty-five-kilowatt dynamo, belt-driven from a Corliss engine, it was hard to scare up a load for this equipment. The system referred to is in the shape of a card which can be properly indexed and contains spaces for the room number, telephone number and class of connection. There are also proper spaces for the cross-connections from underground cables to rooms. Each of the underground cable pairs has a special number and each cellar cable pair has a special number. The shafts through which the different leads are run are also designated by special numbers. The floor box has its number, and the back of the card contains spaces for the date upon which examination is made, the trouble found, and the initials of the man locating or working on the repair. If, at any time, trouble is found on any part of the service, the room and apparatus are located and, by means of these cards, the circuit is promptly identified and there is no chance of hit or miss calculations. This system will be eventually applied to include the lighting and power circuits throughout the entire range of electrical apparatus.

The clock system is electrically synchronized, eighty Howard electric clocks working from one master clock. A special system has been designed for this apparatus by Mr. Heimbold, in that each clock has an individual circuit, making it possible to synchronize all of the clocks at any time, or to synchronize any clock individually. These clocks are all operated from dynamo current through special resistance. The storage battery is also connected to this resistance. In case of the failure of the dynamo current and the consequent operation of the circuit-breakers, the storage battery is automatically switched in, so that there is absolutely no interruption in the synchronism of the clocks. All of the annunciator and telephone service in the building is operated on dynamo current which is generated by two sets of Holtzer-Cabot motor-generator apparatus, one set being in continuous service, and one set being held in reserve.

Two of the Generating Units, Prudential Insurance Company, Newark, N. J.

The storage battery equipment consists of sixty-five cells, with a capacity of 800 ampere-hours. Fourteen of these cells are end cells. A card system has also been devised for the regular inspection of the storage batteries, and the engineer makes examinations and enters a complete report every half hour. The cells are charged every morning and carry current for the night load.

In addition to the electric equipment, the engine room contains the pumping equipment and apparatus for the elevator installation, a number of other pumps, and a feed-water heater. The room is also equipped with two eight-ton, hand-power traveling cranes of twenty-two-foot span, built by the Reading Crane Hoist Works. The elevator equipment includes three compound three-cylinder Laidlaw-Dunn Gordon pumps, the three cylinders located side by side and driving three water plungers, a safe lifting pump and two pilot return pumps. The large pumps have one seventeen-inch and two nineteen-inch steam cylinders, five-inch water plungers and a twenty-four-inch common stroke. For regular service a pressure of 750 to 800 pounds is maintained by the pumps. With this high pressure, instead of the pressure tank usual in low-pressure systems, accumulators are used. For the satisfactory operation of the valves and the elevator cylinders, a low-pressure hydraulic system has been installed, for which purpose the pilot return pumps have been provided, maintaining a pressure of eighty pounds. Three ten by six by ten-inch Laidlaw-Dunn-Gordon duplex pumps are a part of the mechanical equipment. Two of these are for house and fire service, and the third is for boiler feeding. A Berryman steam tube feed-water heater, containing 1,690 lineal feet of two-inch seamless drawn brass tubing, is also located in the engine room; this heater is fifty inches in diameter and seventeen feet in height.

The exhaust steam from the engines is collected into an eighteen-inch main, and that from the elevator pumps into a twelve-inch main, the two uniting in a twenty-inch main. The exhaust first passes through a tank twelve feet long and four feet in diameter, which is a Utility combined grease extractor and muffler tank. The exhaust next reaches a connection to the feed-water heater, about which it has a by-pass in the cellar. From this point the steam may pass into the heating system for the buildings or into the atmosphere, the latter pipe being fitted with the usual back-pressure valve. The different mains for the steam and hydraulic and electric connections are carried by means of underground tunnels connecting the different buildings.

The boiler plant is located in a room forty-five by seventy-nine feet, and is provided with coal and ash-handling machinery and a large overhead storage hopper or bin, allowing a gravity flow of coal to the firing space. Below the firing

floor there is a cellar containing boiler-feed pumps, a number of tanks, and the conveyors for hauling coal and ashes. In the boiler house, in addition, there are an elaborate ventilation plant and a refrigerating plant for furnishing iced water.

There are eight boilers in all, each of 250 horse-power capacity. These are arranged in four batteries, with space for a fifth battery. The boilers are of the Babcock & Wilcox Company's construction, being made of wrought steel. Each boiler is nine sections of tubes in width, each section having twelve four-inch tubes eighteen feet long. The steam drums are forty-two inches in diameter and twenty-three feet four inches long, made up of one-half-inch plates. Each boiler has 2,217 square feet of heating surface and 39.1 square feet of grate surface. The boiler plant is served by a masonry double-shell chimney, rising clear of the building as an octagonal shaft, of Indiana limestone. The chimney has a total height of 230 feet 9 inches, its top being 210 feet above the level of the grates, and has a constant inside diameter of nine feet.

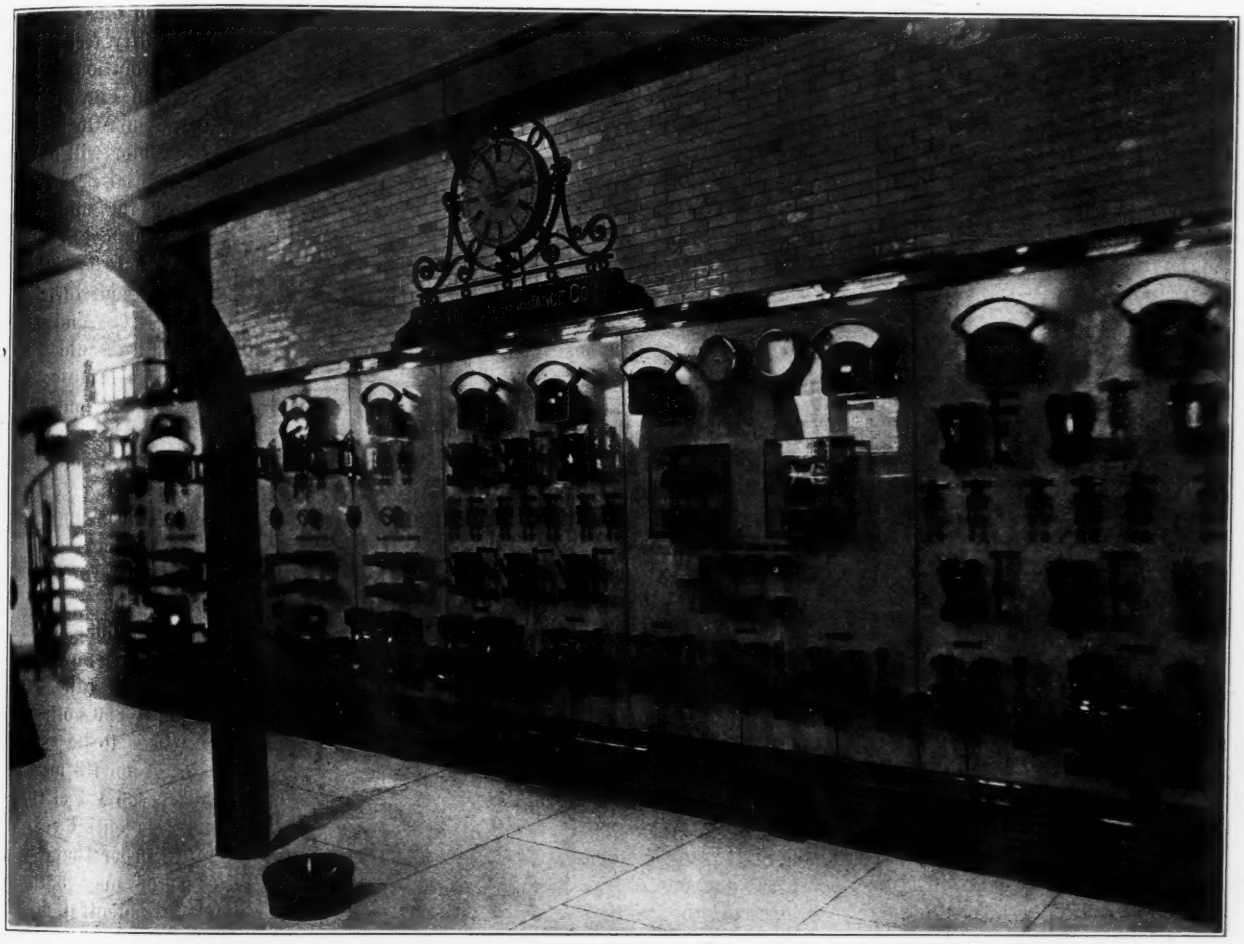
The coal and ash-handling machinery comprises a belt conveyor and a chain and bucket conveyor, the former delivering coal received at the street to the latter, and the bucket conveyor carrying the coal overhead to the bin.

There are two steam headers, each supplied by independent connections from each of the boilers. One twenty inches in diameter collects steam for the electric generating units, and the other, eight inches in diameter, receives steam for the various pumps, this header being provided in the boiler by a cross-connection with a larger header, and joined in the cellar under the engine room with a main from the larger header, so that the pumps of the elevator installation can obtain steam from either source.

The architect for the buildings is Mr. George B. Post, of New York, and all engineering work in connection with them was done under the supervision of Mr. Amory Coffin, as engineer. The power and heating, piping and the ventilating apparatus were installed by Messrs. Baker, Smith & Company, of New York, and the electrical work, for which Messrs. Pattison Brothers were retained as consulting engineers, was done by Messrs. Hatzel & Buehler, of New York. The switchboard was constructed by the General Incandescent Arc Light Company. The elevators were installed by the Otis Elevator Company, for which Messrs. W. T. Hiscox & Company, of New York, were subcontractors.

The entire work on the different buildings and the greater part of the credit for the equipment of the mechanical plant are due to Mr. Tysilio Thomas, the supervising architect. Mr. Thomas was in charge of the architecture of the Prudential buildings in association with Mr. Post, and upon the real estate business of the Prudential company assuming such extensive proportions, he was engaged permanently by the company as assistant superintendent of real estate.

The mechanical plant is now under the care of Mr. Edward G. Lender, who occupies the position of chief engineer for the Prudential company.



THE SWITCHBOARD, MECHANICAL EQUIPMENT, PRUDENTIAL INSURANCE COMPANY OF AMERICA, NEWARK, N. J.

CONTINUOUS-CURRENT MOTORS FOR MACHINE TOOLS.*

BY F. O. BLACKWELL.

The application of electric motors to machine tools is a subject requiring a great deal of study in order to obtain the best results, each case having to be treated as an individual. In most shops it might be economical to have the bulk of the machines driven by individual motors, while in others group-driving would be better.

Planers, slotters, milling cutters and many other tools need only a slight variation in speed, as the relation between the tool and its work is always the same, variation in speed only being required for different classes of work—that is, for hard or soft metal or for a roughing or a finishing cut. Such work does not require more than a 2 to 1 variation, while, on the other hand, lathes, boring mills and other rotating tools may require an 8 or 10 or even 40 to 1 variation, necessitated by the varying relation between the tool and its work—different diameters of the work. For instance, take a lathe in which is being turned a shaft six inches in diameter, to obtain a cutting speed of fifty feet per minute, it will require approximately thirty-two revolutions per minute of the main spindle, while if the flange of a forty-eight-inch wheel was being turned, it would require only four revolutions per minute of the spindle to obtain the same cutting speed. It can therefore be seen that such tools of necessity require a large amount of speed variation to obtain the best results.

There are a number of methods in use for attaining variable speed by means of the electric drive, the more common being rheostatic, field and multiple-voltage control.

Rheostatic control is obtained by introducing resistance in series with the armature of an electric motor, the speed being reduced in proportion to the power consumed in the resistance. Therefore, if a constant horse-power is desired at the tool, a motor when running at reduced speeds receives a reduced potential and requires an increased current. For example: If a motor is running at one-half its normal speed it receives but one-half the line potential and requires double current. For this it will be seen that as the rheostat is consuming practically one-half the power applied, the efficiency of the combination is less than fifty per cent. This method of control is undesirable, not only on account of its being very inefficient, but also from the fact that as the load decreases the speed increases; and should a man be working on a piece of material where the cut takes only part of a revolution, the speed will immediately increase, as the tool leaves the work, to such an extent that in all probability the tool will be burned or perhaps broken when it enters the work again. The rheostatic control is therefore undesirable and wasteful of power.

By varying the current flowing in the field coils of the motor the strength of the magnetic field is changed, and the speed of the motor varied. With any setting of the field, however, the motor will give constant speed under changes of load, and this method therefore avoids the greatest objection of rheostatic control. A motor of ordinary design will not always permit of any considerable weakening of the field without sparking at the commutator, but with a motor having small armature reaction a variation in speed of 2 to 1 can readily be obtained, and when delivering a constant horse-power the current will be approximately the same at all speeds, because the potential across the armature terminals is always the same. As the field current of a motor is only a small fraction of the total current, the efficiency of this method of control is practically the same at minimum and maximum speeds; it also allows the use of a much smaller controller and renders it possible to get a greater number of running speeds than can be economically arranged for with any other control.

Multiple-voltage control is obtained by having several different line potentials to work from. For instance, with the Edison three-wire system the potential from the neutral to the outside wires is one-half the potential between the outside wires. There are, therefore, two potentials available, and a motor connected between the neutral and one outside wire would run at one-half the speed it would when connected across the outside wires.

A four-wire system may also be used in the same manner, giving various combinations of potentials, the minimum of which may be about one-fourth or one-sixth of the maximum potential.

Either of the above methods combined with the field control of the motor makes a very flexible system. For example, a motor having 100 per cent field control used on the three-wire system will give a speed variation of 4 to 1, or a motor having thirty-five per cent field control used on a four-wire system with potentials of 60, 80, 110, 140, 190 and 250 volts will give a speed variation of approximately 6 to 1, or having potentials of 40, 80, 130, 170, 210 and 250 an 8 to 1 speed variation, the gaps in speed between the various potentials being filled in by field control of the motor.

Having at hand an easy method of control, the question arises as to how far can we efficiently apply this method to advantage. It has been demonstrated many times that it takes practically a constant horse-power to remove a given amount of metal per minute, irrespective of the rotative speed of the tool. Therefore, the main spindle of a lathe taking a three-eighths-inch cut on a six-inch steel shaft with a feed of one-eighth-inch and a cutting speed of fifty feet per minute makes thirty-two revolutions per minute, and takes a certain horse-power to drive which we will assume to be fifteen horse-power, and the motor will be working on its highest potential or 250 volts. Now, if we are using the multivoltage system with the last-named potentials above, and should put a forty-eight-inch wheel in this same lathe and turn up its rim with the same cut, feed and cutting speed, the main spindle would run at about four revolutions per minute or one-eighth of the previous speed, but still require fifteen horse-power to drive. With this condition the driving motor would have to run on its lowest potential or forty volts, and would be consuming fully six times the amount of current it did previously. You will therefore see that a motor to be used on the multivoltage system will have to be sufficiently large to carry its maximum horse-power at the minimum potential, or, in other words, at, say, forty volts on a 250-voltage system, the motor will have to be six times too large when working on its maximum potential. For this reason I feel that we must keep the lowest potential employed as high as possible in order that the size and cost of the motor may be within reasonable limits. A potential of forty or sixty volts requires such large conductors, if they are laid out for a small drop, that their cost is prohibitive in a plant of any size. If a large drop is used, the motor falls off in speed under load and its speed regulation under changes of load is little better than with the rheostatic control.

With the three-wire system and a 100 per cent variation in the motor speed by field control, we can obtain a 4 to 1 total variation which, for general machine-shop work, is sufficient to cover a single operation on a given tool. The total range, however, on a tool can be increased greatly by having a few gear changes. For ex-

*A paper read at the 170th meeting of the American Institute of Electrical Engineers, New York, November 21, 1902.

ample, on a back-geared lathe with a gear ratio of 4 to 1 a total variation of 16 to 1 can be obtained. In the same manner on a double-geared lathe a variation of 64 to 1 might be obtained.

The reduction effected by different sets of back-gears on machine tools will be found to vary from 4 to 1 to 6 to 1. All tools can be arranged with 4 to 1 changes between back-gears without any difficulty. In many cases a single back-gear is sufficient for a tool. By putting a magnetic clutch on this back-gear and making the electrical connections in the controller, it is possible to get a 16 to 1 variation electrically and without increasing the cost of the motor more than would be required for a 4 to 1 variation.

Where machines must run at various speeds, the usual practice has been to employ step cone pulleys and changeable gears. The speeds obtained in this way, however, are few in number, and, therefore, as a wide range of speed is necessary the different speeds must be far apart. The minimum speed change of lathes, for instance, is usually from twenty-five per cent to fifty per cent. If the speed with one combination of gears and pulleys is a little too high, it can be reduced to the next lower speed (twenty-five per cent to fifty per cent power) with a loss of output nearly equal to the reduction in speed. If, on the other hand, power is furnished by a variable speed electric motor with a range sufficient to fill in between the mechanical steps, the tool may be driven always at the highest possible speed and maximum production. This is best illustrated by the curves plotted from a test on a seventy-two-inch lathe.

This showed the cutting speeds and the time taken to face a seventy-two-inch cast-iron disc from a maximum diameter of seventy-two inches to a minimum diameter of six inches, using three different steps of the cone pulley, the time for shifting the belt from one cone to the other not being included. The cone pulleys on a mechanically driven tool do not permit the tool to start at the maximum cutting speed, and in this case the mechanic, having no guide but his eyes, did not change the speed on the cone pulley as soon as desirable for greatest production.

Another curve shows a test on a similar lathe, but driven by a motor. With the electrically driven tool the cut begins and ends at the maximum cutting speed that the work permits.

The curves show that a belt-driven lathe required fifty-nine minutes to complete the cut, while the motor-driven lathe did the same work in thirty-one minutes. The electrically driven tool, therefore, did the work in fifty-three per cent of the time, or, putting it another way, the belt-driven tool required ninety per cent more time to do the same work.

With electrical control a man can keep his hand on the controller and his eyes on the tool, increasing the speed from time to time. Being limited only by the temperature of the tool, it has been found that much higher cutting speeds are unconsciously attained with a motor-driven tool than would be thought possible were any fixed rule followed. It is therefore apparent that this increased production in many cases is so great as to fully justify the installation of an electric system, even if there were no other advantages to be secured.

The cost of motors varies with their size and (for a given horse-power) nearly in proportion to the variation in speed which can be obtained from them. The approximate relative sizes of the motors expressed in the horse-power capacity at which they could be rated at the maximum potential are about:

For the three-wire, twice as large as for the two-wire.

For the four-wire, four to six times as large as for the two-wire.

System.	Speed Variation.	Ratio of Maximum Horse-Power.
Two-wire.....	50–100	100
Three-wire.....	25–100	200
Four-wire.....	16–100	400
Four-wire.....	12–100	600

Besides the cost of the motor, there is to be considered with the four-wire system the cost of the supply plant—that is, the generator, motor-generators and conductors.

The three-wire system is now generally employed for lighting, and requires no special appliances. Nearly all central power stations distribute their current for lighting and power on the three-wire system, so that it can generally be obtained and the erection of a special power plant avoided. The three-wire system can be always arranged so that the motors running at one-half potential will be equally divided between the two sides of the system, which will therefore be in balance, and as there is but little or no current flowing in the neutral wire it can be of nominal size. The three-wire system does not necessarily require two generators or a balancer set, an alternating neutral with collector rings on the generator being extensively employed.

The four-wire system requires a three-commutator motor-generator set, which must have sufficient current capacity at the lowest potential to run all the motors that could ever be in service at one time at their full horse-power at that potential. The motor-generator set and the heavy wiring for the low potentials of the four-wire system will much increase the cost, exclusive of motors, as compared with a three-wire system. If the motors are made of sufficient capacity to run the rotary tools at reduced speed, and the motor-generator set and distribution cables are made of proper size to take care of the unbalanced load, the four-wire system will altogether cost several times as much as the three-wire system.

In conclusion, I would say that in my opinion it will generally be found best to use motors with field control, allowing a total speed variation of 2 to 1 with the two-wire system or 4 to 1 with the three-wire system, believing that the four-wire system is too expensive for general application if the plants employing it are properly designed and equipped with large enough electrical apparatus.

For reciprocating tools a two-wire system will meet all requirements, and there are very few rotating tools where it is not better to mechanically vary the speed for greater than 4 to 1 changes in speed.

The most important consideration in the electric driving of machine tools is to make the control of the tool as convenient as possible and arrange the system so as to permit small changes in speed, and consequently be able to always drive the tool at its highest possible speed and greatest output.

Useful Notes for Electrical Engineers.

A little handbook recently issued by the National Boiler and General Insurance Company, Limited, London, gives the following useful notes for electrical engineers: Maximum permissible temperature of dynamo and motor coils, 150 degrees to 160 degrees Fahrenheit; watts = volts × amperes; 1 watt = 44½ foot-pounds per minute; 746 watts = 1 horse-power; 1,000 watts = 1 kilowatt; 1 horse-power = 0.746 kilowatt; 1 kilowatt = 1.34 horse-power; 1 Board of Trade unit = 1 kilowatt for 1 hour; 9 to 10 sixteen-candle-power lamps require 1 horse-power; 1 sixteen-candle lamp at 100 volts takes 0.48 to 0.6 ampere; efficiency of small dynamos, about 85 per cent; efficiency of large dynamos, about 93 per cent; efficiency of steam dynamo sets, 70 to 75 per cent; 1 kilowatt requires from 1¾ indicated horse-power to 2 indicated horse-power to generate it. Keep damp, dust and oil off wiring and insulation. Electric driving is often suitable for scattered or intermittently loaded machinery.

ELECTRICITY FROM REFUSE—THE CASE FOR THE MODERN DESTRUCTOR.*

BY W. FRANCIS GOODRICH.

It has often been said that the destructor maker places too high a value on refuse as a fuel, and that with a view to leading innocent and trusting municipalities up to business, extravagant promises have been made concerning light from dust.

At the outset it may be as well, therefore, to observe, firstly, that the sanguine and enthusiastic individual who gained notoriety as "The Golden Dustman," was not a destructor maker but a municipal engineer; secondly, that Professor Forbes, whose remarkable cantor and other lectures fourteen years ago with reference to the production of electric light from refuse, is no mean member of your own profession, and, lastly, he who gave Shoreditch his blessing with eloquence and epigram which the destructor maker could scarcely hope to equal, is the most distinguished member of your profession and a world-famed scientist—Lord Kelvin.

I do not suggest that the destructor maker has been of a conspicuously retiring nature, or that the guarantees offered have been distinguished for their modesty, on the other hand we know only too well that ridiculous promises have been made. We also know that the absurd results promised—but not realized—a few years since, had the effect of bringing the combination into ridicule.

Happily the prejudice is passing, from a state of enthusiasm run riot, we have now entered upon a sober period, the real value of the destructor as an adjunct to an electricity works is now more clearly understood. Experience has shown exactly how far, and under what conditions, the destructor may be relied upon as a power producer. Experience has also shown its weaknesses, and if we are to gain knowledge worth having we must be even more ready to detect weakness than to congratulate ourselves upon success, for we can only hope to approach perfection by the elimination of weakness.

I venture to say that the best of modern destructors have only been designed by a process of improvement. Of course there are members of your profession who still assert most positively that the available power is really only suitable for operating mortar mills and similarly modest machinery which require but little steam, and at any reasonable, or may be unreasonable, pressure.

If we are to take such statements as these seriously then we must perforce believe that we have made no progress during the past fifteen years, because the destructor of fifteen years ago was quite equal to supplying steam for the work in question.

Can it be seriously argued then that the destructor of to-day is but on a par with its earlier prototype, is it a fact that while every other branch of engineering has a record of remarkable progress, this particular branch has stood still? It is not necessary for me to supply the answer, those of you who have seen the early type of destructor know that immense strides have been made.

Why was the old low temperature type of destructor of little use for power production, and why was it the cause of endless annoyance and litigation? Broadly speaking, for one and the same reason—worked at a low rate of combustion limited by natural draught, low temperature gases only came into contact with the boiler, fifteen years since it is safe to say that the temperature of the gases entering the boiler never exceeded 800 degrees Fahrenheit, frequently falling as low as 600 degrees Fahrenheit. Now in our best modern practice gases enter the boiler at a temperature of 2,000 degrees Fahrenheit, or even higher, and in a well managed plant the minimum temperature can be kept at 1,600 degrees Fahrenheit.

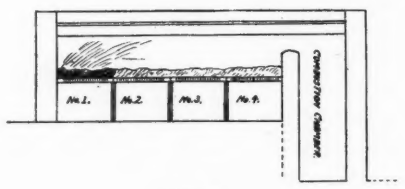


FIG. 1.

When No. 1 is clinkered and charged Nos. 2, 3 and 4 are in full work, the gases as distilled from No. 1 must pass over and intermingle with the whole volume of ignited gases from Nos. 2, 3 and 4.

In the face of this is it not reasonable to expect very different results in the way of power production, and is it not to say the least of it a short-sighted policy to still tie the destructor to the despised mortar mill?

Continuity of high temperature is the essential for securing steady steaming, and in designing a destructor, combined with an electricity works, this is the cardinal point to be borne in mind.

At the Glasgow convention of the Municipal Electrical Association Mr. J. S. Highfield argued in favor of the system of erecting cells in pairs, so that one out of the two cells should always be in full work while its fellow is being charged and clinkered; this arrangement is an essential feature of the Beaman & Deas destructor with which is also provided one combustion chamber common to both cells, where the gases must commingle before reaching the boiler.

Why did Mr. Highfield thus argue? We may assume that he had found by actual experience that this design with the alternate system of working conduced to easy maintenance of high temperature and so steady steaming.

In the ordinary arrangement of single cells, either in single row or back to back, one cell does not help its neighbor excepting of course that the gases intermingle in the main flue, so far as the cells themselves are concerned there is isolation of heat, and it may be assumed that there will be a difference in temperature of fully 1,000 degrees Fahrenheit in a cell which is being clinkered and charged and its neighbor in full work, it is therefore difficult to ensure that continuity of high temperature which is necessary for steady steaming.

The same may be said of the system of placing one boiler between two cells, for with the boiler between it will be obvious that the one cell can not assist its fellow in the maintenance of high temperature during clinkering and charging and so you may have a cell in full work on one side of the boiler, while on the other side is a comparatively cool cell, which after being charged must, while in a cool condition, distill a large volume of green gases; this volume should obviously be caused to intermingle with a high temperature volume to secure thorough cremation, but instead comes into immediate contact with the comparatively cool surface of the boiler plates or tubes.

To approach as near as possible to this desired continuity of high temperature and to render it as easy as possible for such continuity to be secured, I am led to believe that we must not place so much reliance upon what may happen beyond the furnace or cell—that is in the main flue or combustion chamber as the case may be, we must rather begin at the beginning, and so design the plant that there shall be a continuity of high temperature in the cell itself, if easy continuity of high temperature can be secured in the cell then we need not trouble about what may happen after.

To attain this object there must be no isolation of heat, a hot cell next to a cool one is not to be recommended; to secure the object in view there is a system

* Paper read before the Manchester Section of the British Institution of Electrical Engineers, November, 1902.

which provides four cells in one cell, if I may so put it. I refer to Meldrum's system of continuous grate with divided ashpits, the arrangement of which may be clearly seen by reference to Figs. 1, 2, 3 and 4, here you have one cell with 100 square feet of grate surface, a grate twenty feet long by five feet wide, with a separate ashpit for each twenty-five square feet of grate. As one-fourth only of the cell or grate is clinkered and charged at a time, three-fourths of the cell as a cell is always in full work.

Thus when grate No. 1 is clinkered and charged, the gases as distilled must pass over and intermingle with the large high temperature volume passing from grates Nos. 2, 3 and 4. When No. 2 is clinkered and charged it is in a zone of active fire, No. 1 grate is discharging its volume of high temperature gases over the idle grate, the whole volume of which must then pass over and commingle with the volume passing from grates Nos. 3 and 4. When No. 3 is clinkered and charged as with No. 2, it is also in a zone of active fire, having fifty square feet of active grate on its left and twenty-five square feet also on its right.

When No. 4 is clinkered and charged it is true, as we are occasionally reminded, that it is next to the combustion chamber, but seventy-five square feet of active grate on its left discharge their high temperature volume over the idle fourth, and it must not be forgotten; firstly, that the combustion chamber beyond is kept at a high temperature, because as you will have seen three-fourths of the cell is always in full work, and secondly—and this is a point of great importance—no large volume of green gases ever enter the combustion chamber, the refuse being fed in small quantities by shovel, and not by the ton or load.

Feeding by shovel in small quantities into an active cell means rapid distillation and also rapid ignition, the gases from such small charges or refuse being naturally small in volume, the temperature as a whole does not materially suffer.

I think you will readily appreciate the striking difference between feeding refuse in small quantities into a hot and active cell and the system of dumping a heavy charge into a cool and idle cell.

There can be no doubt that the regenerative system by which heated air is supplied for combustion is of material advantage in the maintenance of high temperature; Professor Watkinson, of Glasgow, and other eminent authorities, have clearly shown how efficiency may be promoted with steam boilers and coal, and it has been demonstrated again and again in burning refuse that the use of heated air not only tends toward giving a better fuel efficiency, but it has a most beneficial effect in the cell in promoting rapid ignition and easy continuity of high temperature.

In rainy weather, when refuse is brought in heavily charged with moisture, the use of heated air is an obvious advantage in a combined works, especially, because in rainy weather with dull periods the big demand for light is often very exacting, and instead of decreased efficiency of the destructor, greater efficiency would be welcome, but while this is impossible, yet no means should be wanting for preventing any material loss of efficiency.

With Meldrum's patent regenerator the air is heated on an average to a temperature of 350 degrees Fahrenheit, although as will be observed in test D, at Lancaster, an average of 478 degrees Fahrenheit was obtained.

It is interesting to observe also that the use of the regenerator does not prevent the inclusion of an economizer, both can be installed, and both will give an excellent efficiency.

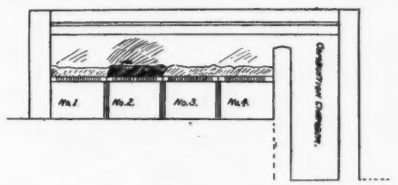


FIG. 2.

When No. 2 is clinkered and charged it is in a zone of active fire. Nos. 1, 3 and 4 being in full work and at their greatest heat.

It has been said that thorough cremation and really efficient power production are not compatible, and that they can not take place coincidently; extremists have told us that if due attention is given to the primary purpose of the destructor it will be of little service for power production.

Seriously as this has been urged, and to the detriment of useful combination, it is an argument which will not stand. It is true that if the steam boiler was placed in the very best position for heat absorption the destructor would be inefficient as a destructor, but it is equally true that the destructor, which is most satisfactory as a destructor, is the one which is so designed that the products of combustion are subjected to immediate high temperature contact, and of sufficient duration to secure their perfect cremation.

In this process a large volume of high temperature gases is produced which passes to the boiler, and that continuity of high temperature, which is of the utmost value from a sanitary standpoint, is at the same time the justification of the destructor as a power producer.

I have already referred to Mr. Highfield's admirable paper read at the Glasgow convention of the Municipal Electrical Association last year. In the main I am in agreement with Mr. Highfield—I should like to observe that so far as I have been able to judge quick charging appliances and mechanical devices for the handling of refuse can not be recommended. Mr. Highfield advocates "quick charging appliances," which I understand to mean apparatus having for its object the rapid charging of a quantity of refuse at each operation.

That being so, then I must say that although such a device is exceedingly desirable from a sentimental and highly sanitary standpoint, it does not conduce to that easy maintenance of high-temperature working, which we must aim at and ensure if the destructor is to fulfill either its primary or its secondary object.

I have had many opportunities of watching what I believe to be the most expeditious charging device yet produced, an arrangement by which from thirty to forty-five hundredweight of refuse can be tipped in a few seconds direct from the van into the cell.

Previous to tipping the van load into the cell the clinkering process has taken place, no device has yet been introduced for rapid clinkering, it is an arduous job occupying, say, fifteen minutes, after burning down a similarly heavy charge. During this time the cell isolated from its neighbor becomes comparatively cool, directly the load is tipped, falling, as it does, into a compact mass, the leveling or spreading process begins, the cell still cooling, still inactive, and by the time all is ready for active treatment the cell is cool; it has been idle for from twenty to twenty-five minutes. Look into the cell and you will observe an appreciable lack of temperature such as is wanted, firstly, for thorough cremation and, secondly, for power production.

In ordinary top or back feed systems the same principle applies, excepting that the labor of leveling is reduced by reason of the smaller charges, but whether the charge weighs fifteen hundredweight or forty hundredweight the fact remains that by reason of a large volume of green gases passing into the main flue or combustion chamber the temperature as a whole must be affected, and the steam pressure fluctuates accordingly.

If you recognize refuse as a fuel then

you must be prepared to so charge or feed it that perfect cremation is ensured, and that easy continuity of high temperature is conduced to. We have often heard that the secret of properly burning coal is to fire "a little at a time and often." I submit that this is also the best way to burn refuse. No one would think of dumping one ton of coal on to a grate, on the other hand we know full well that in the destructive distillation of coal it is best from every point of view to introduce the fuel regularly, in small quantities, so that thorough ignition is secured, and a high-combustion temperature.

There is another aspect of the charging question, and that is the economic aspect upon which I need not dwell at any length, there being ample evidence that mechanical charging, generally speaking, adds from thirty to fifty per cent on the cost of labor per ton destroyed over all systems where manual labor alone is employed.

The average cost per ton of refuse burned for labor only at electricity works in the provinces is only a fraction over one shilling per ton, but if the London installations are also included, the average is inflated to one shilling and eightpence per ton. An analysis of the comparative rates of wages paid in town and country shows that the extra cost is only to a slight extent due to the higher rate of wages paid, but that it may in the main be attributed to the elaborate mechanical devices installed with a view to saving labor, but which are in actual practice found to involve increased labor cost.

There can be no question that in order to obtain the greatest possible advantage from a destructor in combination with an electricity works the electrical engineer should have supreme control.

In saying this I do not disparage that excellent body of public officials—municipal engineers and surveyors—I think it was Professor Kennedy who once said that the man who is responsible for running the engines should control the steam production—that remark puts the case concisely, and I think reasonably.

It is a common idea that labor is difficult to obtain in connection with destructors, and that where a considerable amount of power is expected from refuse, continuous trouble may be expected, but strange as it may seem, it is very well known among those who have to do with destructors that labor is not difficult to obtain.

Although one would scarcely expect to find a Mark Tapley charging refuse, yet it is common to find a cheerful energy in the destructor house which is too often wanting in the ordinary stokehole.

It is indeed curious and almost unaccountable to find men uncomplainingly doing their level best with refuse, while others who are provided with good coal to burn are found in a state of chronic passive blasphemy.

Out of a total number of 160 towns in Great Britain, where destructors have been adopted up to the present time, no less than forty-five towns have decided to combine the destructor with the electricity works. When it is borne in mind that no less than forty-three of these combined installations have been decided upon during the past three years, it must be admitted that remarkable progress has been made.

The actual destroying capacity of the destructors already adopted in combination with generating stations may be put at upward of 1,400 tons of refuse daily.

At the risk of wearying you with a few figures, I would observe that out of the

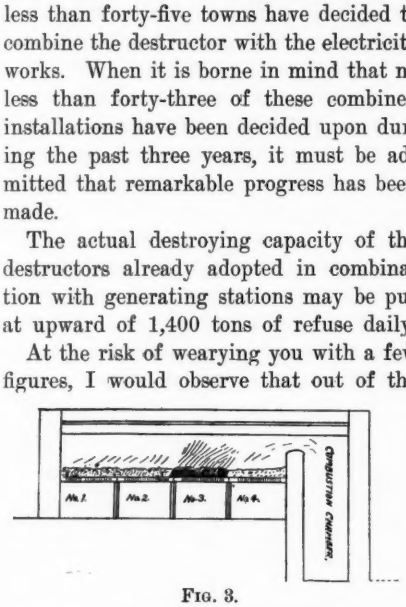


FIG. 3.

When No 3 is being clinkered and charged it is also in a zone of active fire, Nos. 1, 2 and 4 being in full work and at their greatest heat.

forty-five combined works in question, no less than twenty-four have adopted Meldrum destructors, fifteen of these being of the Meldrum front or hand-feed type, only one of the top-feed type, and eight of the Beaman & Deas type, which patents are, of course, controlled by Messrs. Meldrum.

I would lay particular stress upon the fifteen installations where the hand-feed type of destructor has been adopted, covering as they do towns from Grays in the South to Ayr in the North, they serve to clearly show that hand feeding is popular, while the results obtained in thorough cremation, efficiency in power production and low labor cost place this type of destructor in advance of any other.

Destructors have not been adopted at any considerable number of sewage works, although the combination is an eminently useful one, and one devoutly wished for by those who are afraid of the central site, and also some electrical engineers who still tremble at the thought of combination. Destructors have been adopted in connection with sewage works in twenty-six towns, and in passing I would just point out that in fourteen of these towns Meldrum destructors have been adopted, it will thus be evident that this particular type of destructor has been favored in the majority of towns where power is required from refuse.

In comparing the number of these installations with the forty-five towns, where destructors have been adopted in connection with generating stations, one is again reminded of what has been called "that strange fascination for producing light from dust."

Very few figures are available over sufficiently long periods to be of general interest. Forty and even fifty units have been generated per ton of refuse destroyed over short periods, but I have thought it advisable not to include figures for any shorter period than one month.

At Garston, where a Meldrum destructor has been erected in combination with the Electric Traction station, I understand that very remarkable results are being obtained, but as the figures have not been officially announced I must refrain from mentioning them.

It will be observed that the figures here given in each instance cover a period of not less than one month, and in the case of Darwen and Shoreditch a whole year.

The installations at Darwen, Wrexham and Shipley are of Meldrum's hand-feed type, Accrington being one of the Horsfall Company's more recent installations, Patrick, the latest combined plant erected by Messrs. Manlove, Alliott & Company, Limited, and Shoreditch also erected by this company.

Town.	Period.	Units Generated Per Ton of Refuse Destroyed
Patrick.....	Aug., 1902 (1 mo.)	20.1
Accrington...	Nov., 1901 "	20
Shipley.....	Jan., 1902 "	37.4
Wrexham	Nov., 1901 "	37.8
Darwen	One year	33
Shoreditch....	One year	20

Mr. R. W. Smith Saville, the borough engineer of Darwen, has kindly given me permission to state that for the year ending March 31, 1901, the average evaporation per pound of refuse was 1.25 pounds taken over a total quantity of 10,000 tons.

Further, that 2,940,000 gallons of water were evaporated with the coal-fired boilers at a fuel cost of £1,250, and that the destructor boilers gave a net evaporation of 2,520,000 gallons which quantity would have involved a further expenditure of £1,050 for coal had the refuse destructor not been combined.

Mr. J. A. Priestley, of Nelson, made a

number of careful and very exhaustive tests with the Meldrum destructor in that town, which plant is now combined with the electricity works. These figures are well worth careful study and comparison; a short extract from three tests is here given:

(A)—EXTRACT FROM FIGURES OF TEST MADE AT NELSON, DECEMBER 20, 1900.

Duration of test, 9½ hours; grate area of cells, 100 square feet; heating surface of boiler, one Lancashire type, 30 feet by 8 feet, 986 square feet; refuse consumed per hour, 5,703 pounds; refuse consumed per square foot of grate per hour, 57 pounds; water evaporated per hour, from and at 212 degrees Fahrenheit, 8,650 pounds; water evaporated per pound of refuse from and at 212 degrees Fahrenheit, 1,516 pounds; average percentage of CO_2, 12.21 per cent; average temperature of combustion chamber, 2,200 degrees Fahrenheit; percentage of clinker, 21.18 per cent.

Note.—The boiler was not clothed when this test was made.

(B)—EXTRACT FROM FIGURES OF TEST MADE AT NELSON, APRIL 25, 1901.

Duration of test, 8 hours; refuse burned per hour, 6,853 pounds; refuse burned per square foot of grate per hour, 68½ pounds; water evaporated per hour, from and at 212 degrees Fahrenheit, 13,442 pounds; water evaporated per pound of refuse, from and at 212 degrees Fahrenheit, 1.96 pounds; water evaporated per square foot of heating surface from and at 212 degrees Fahrenheit, 13.6 pounds; average percentage of CO_2, 14.40 per cent; average temperature of combustion chamber, 2,227 degrees Fahrenheit; percentage of clinker, 29.06 per cent.

Note.—The boiler was covered with non-conducting composition.

(C)—EXTRACT FROM FIGURES OF TEST MADE AT NELSON, FROM FEBRUARY 19 TO MARCH 16, 1901.

Duration of test, 473½ hours; refuse consumed per hour, 2,902 pounds; refuse consumed per square foot of grate per hour, 29 pounds; water evaporated per hour, from and at 212 degrees Fahrenheit, 5,379 pounds; water evaporated per pound of refuse from and at 212 degrees Fahrenheit, 1,850 pounds; water evaporated per square foot of heating surface per hour, from and at 212 degrees Fahrenheit, 5.5 pounds; average percentage of CO_2, 13.16 per cent; average temperature of combustion chamber, 19.59 degrees Fahrenheit; percentage of clinker, 30.20 per cent.

The figures of these three tests are of great interest. Tests A and B were short tests undertaken in order to determine actually what could be done under forced conditions, while test C was an extended test under easy conditions.

If the rate of combustion and evaporation is compared in all three tests there will be found ample evidence of useful elasticity. Again, even under entirely opposite conditions the fuel efficiency of the refuse does not materially suffer, the average temperature of the combustion chamber is uniformly high, as is also the percentage of CO_2.

Figures such as these under both forced and easy conditions afford an excellent opportunity for fair judgment. Mr. Priestly does not put forward test B as showing what may be relied upon for every hour of every day, and no destructor maker would be so foolish as to submit the figures of an eight hours' forced test as being average results.

In my opinion, the real value of a test of this kind is to show what can be done in case of emergency, and the fact that a plan is so flexible without material sacrifice of efficiency is in itself a very remarkable testimony as to its usefulness.

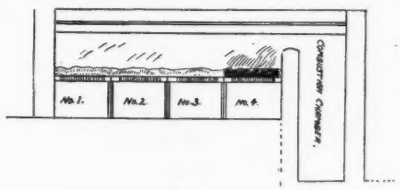


FIG. 4.

When No. 4 is being clinkered and charged the large volume of ignited gases from Nos. 1, 2 and 3, which are in full work, pass over and intermingle with the small volume distilled from No. 4.

The few figures here given of test (D) at Lancaster serve to show that, good as they undoubtedly are, the Nelson figures are only typical of what can be done in other northern towns. I would direct your special attention to the high average percentage of CO_2—15.5 per cent, and also the high average temperature of the air supply for combustion 478 degrees Fahrenheit.

(D)—EXTRACT FROM FIGURES OF TEST MADE AT LANCASTER, FEBRUARY 7, 1902.

Duration of test, 12 hours 26 minutes; grate area of cells, 100 square feet; type and size of boiler, Lancashire, 30 feet by 8 feet; water evaporated per hour, from and at 212 degrees Fahrenheit, 9,820 pounds; water evaporated per pound of refuse, from and at 212 degrees Fahrenheit, 1.63 pounds; average percentage of CO_2 in flue gases, 15.5 per cent; average temperature of combustion chamber, over 2,000 degrees (copper could always be melted); average temperature of heated air from regenerator, 478 degrees Fahrenheit.

Sufficient data are available to show that with a well-designed and well-managed plant at least thirty units per ton of refuse burned may safely be relied upon the whole year through, this is a reasonable estimate as will be seen by comparing the figure with the averages over extended periods.

It is quite true that in many places the summer refuse is not so useful from a power-producing standpoint as that collected during the winter months, but it should not be forgotten that the lighting period is less, and if as is now often done it should be decided to burn the refuse during the lighting period, then by increasing the rate of combustion, the deficiency in the calorific value may be adjusted.

Of course, as is generally known, it is more satisfactory and economical to burn the refuse over the twenty-four hours instead of the comparatively short lighting period, but the latter method is now much favored and especially commends itself to those who have quite satisfied themselves as to the real value of the combination.

It will be obvious that if in order to obtain the maximum amount of power from the refuse it is decided to destroy the same during the comparatively short lighting period only, then the plant must necessarily be much larger and accordingly so much more expensive.

As Mr. Frank Broadbent recently pointed out in his series of excellent articles in the *Electrical Review* (London), a street lighting load and an accumulator load are desirable factors in the early stages of running a small combined station.

Again, a day motor or traction load is very desirable indeed, but we have to take cases as we find them, favorable or unfavorable, as they may be, and although we have satisfactory evidence of useful flexibility there are limits beyond which the destructor will not go, the quantity of refuse available in a town is limited to so many tons per day, and obviously this quantity does not increase *pro rata* with the demand coming from new consumers, there being no connection whatever between the two. While the output of the works may be trebled the refuse may not increase to the extent of one ton per day. There has been a number of instances where for a certain period the whole of the power required has been obtained from the refuse, but this happy state of things

can not last, and we are therefore brought to this conclusion that the refuse destructor is but a most useful adjunct to a generating station.

In connection with the large combined installation at Ipswich, Professor Kennedy is arranging for the Meldrum destructor to supply steam to a separate engine, which will be supplied with steam from that source alone, this will afford an excellent opportunity for determining what the actual value of the Ipswich refuse is to the generating station, and as the destructor is sufficiently large to deal with the whole of the refuse at present available in about ten hours if necessary, some interesting data should be forthcoming later.

If the destructor is to be relied upon for constant use the whole plant must be so designed and arranged that so far as is possible uninterrupted working is conduced to.

Here again comes in the question of simplicity, and as simplicity is generally conducive to efficiency and reliability it demands careful attention, and one must not be enticed away from the main issue by various devices more or less complicated which in theory seem helpful.

Destructor makers must stand on their own legs; they have no right to expect municipalities to experiment for their benefit at the expense of the ratepayer.

Many consulting engineers now specify an elaborate and complete system of by-pass flues, and some even duplicate flues; others insist that even with two installations, each complete in itself, the arrangement shall be such that easy interchangeability is possible, *i. e.*, so that either boiler can be worked with either cell and *vice versa*.

This is all very necessary up to a certain point; it is perfectly correct to thus provide against all possible contingencies, but it does not conduce to simplicity.

Five years ago consulting electrical engineers, generally speaking, were uncompromisingly opposed to the combination, but now the situation has entirely changed and the consulting profession looked upon the destructor as a valuable adjunct to the generating station. There are still one or two consulting engineers who are not yet wholly converted, but it will not be long before they also fall into line and advocate the combination. They must move with the times and offer their well-informed and enthusiastic municipal clients what they want, and what they will have.

Needless to add in connection with a combined plant careful provision must be made in the general arrangement of the buildings to prevent dust from reaching the engine room.

In the early days of the combination, no doubt, there was cause for complaint, but one hears very little indeed now about the presence of dust in the engine room.

There can be no doubt that the mechanical handling of refuse produces and liberates more dust perhaps than is the case with any system with which manual labor alone is employed, the constant dumping of refuse into lifts, and in and out of transporting appliances, simply means the constant release of volumes of dust into the atmosphere, which even apart altogether from any damage caused to machinery is exceedingly disagreeable, even if not dangerous.

It is difficult to keep a destructor house even reasonably clean under the best of circumstances, and it is therefore necessary in designing a combined works to so place the destructor that so far as is possible it shall be isolated from the power-house.

I can not pretend to deal at any length with the oft debated boiler question in this paper, which I am afraid is already too long. The information available up to date all goes to show that the Lancashire boiler has given excellent results, which may, perhaps, be best summarized as follows:

Taking eight Lancashire towns, four having boilers of the Lancashire type in connection with destructors, and four employing water-tube boilers, the average results in* horse-power obtained per ton of refuse burned works out thus:

Lancashire boilers, 186.6 indicated horse-power-hours per ton of refuse.

Water-tube boilers, 143.8 indicated horse-power-hours per ton of refuse.

For constancy of steam pressure the Lancashire boiler has the advantage, owing to the considerable reserve of heat units in the water, and the available figures serve to show that its record for steady steaming is a very satisfactory one indeed.

Of course the choice of boiler has often to be determined by the space available; further, in the early days of a small combined station, capital expenditure may be kept down by the inclusion of water-tube boilers arranged for supplementary coal firing.

Some time since an enthusiastic and eloquent lecturer, discoursing upon the immense possibilities of refuse for the production of electric light, told his audience that even as the civet cat and the musk rat furnish the base for the most exquisite perfumes, and that as some of the finest aniline dyes and other valuable by-products are obtained from dirty coal, so might they reasonably expect, therefore, in the very nature of things, to obtain the most perfect light from their filth and refuse.

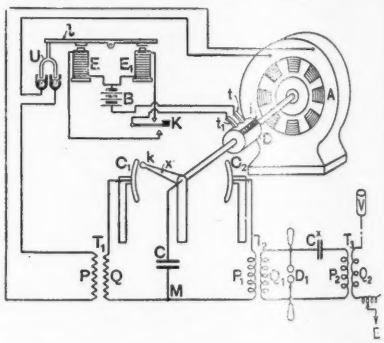
This line of argument, while being interesting and ingenious, is anything but convincing. We may seriously expect to produce electricity from refuse for one reason only, and that because refuse has a calorific value.

As refuse it should be thoroughly cremated, and as fuel the more thorough the cremation the more valuable it is for power production; finally, the more simple the system by which the desired result is attained, the better from every point of view.

*On a basis of twenty pounds of steam per indicated horse-power.

A Recent Wireless Telegraphy Patent.

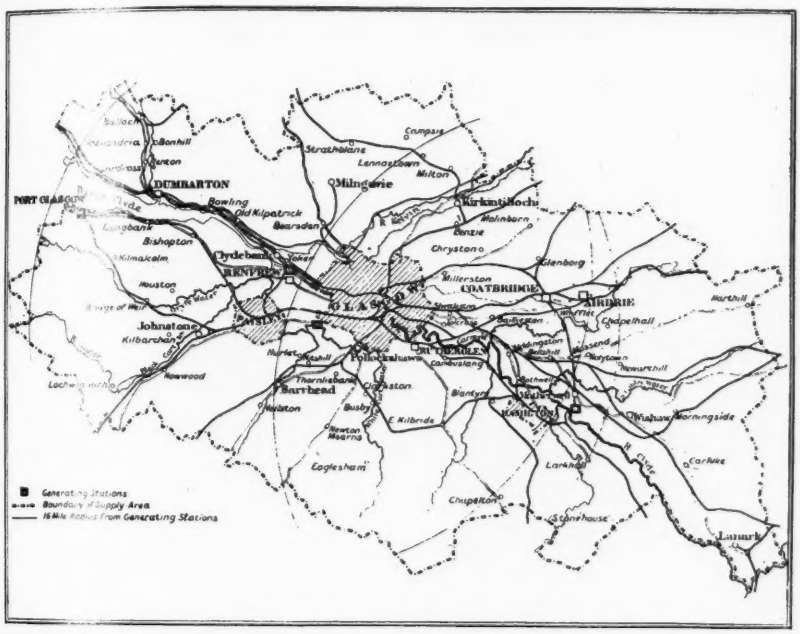
The following apparatus for the production of electrical oscillations has been patented by Professor J. A. Fleming and Marconi's wireless telegraph company. In the figure, A represents an alternator, to the terminals of which is attached the primary coil, P, of a transformer, through a mercury switch, U. This switch is closed or opened by the closing or opening of a local circuit through the key, K. This, by exciting one or the other of the two electromagnets, EE_1, makes connection through the two mercury cups, or breaks



Recent Wireless Telegraphy Patent.

it. The switch arm, L, is so balanced that it remains in either position after being moved. The local circuit is completed through two brushes, $t\ t_1$, which rest upon a segment of a two-part commutator, itself carried on the shaft of the alternator. This commutator prevents the circuit from being opened or closed during the discharge of the condenser, C. To the shaft of the alternator is also attached a revolving arm, x, which, by approaching two sectors, C_1 and C_2, charges or discharges the condenser. The condenser is charged through the secondary winding of the transformer, T_1, and the arm is set on the shaft, so that the circuit will be closed during a period of one-quarter of a cycle and during the time when the electromotive-force wave is at its maximum. This arm does not touch

the sector, but approaches close enough for a spark to pass. After the arm has revolved 180 degrees, it approaches the sector, C_2, and discharges the condenser through the transformer, T_2. This sets up oscillations in the circuit, and hence in the transformer, T_3, and through this in the antenna. The condenser becomes charged to an electromotive force nearly equal to the maximum of the alternator. Good results were obtained when the capacity of C was about half a microfarad. The electromotive force of the secondary circuit of T_1 was 20,000 volts, the alternator and transformer, T_1, both being of twenty-five kilowatts' capacity.—*Electrician* (London), November 14.



MAP OF DISTRIBUTION SYSTEM OF CLYDE VALLEY ELECTRICAL POWER COMPANY, GLASGOW, SCOTLAND.

A Large Power Distribution Scheme to Be Carried Out in Scotland.

A bill has recently been sanctioned by Parliament, which gives authority for an extensive power distribution scheme contemplating the supplying of power to the industrial region of the lower Clyde River in Scotland. The district covered by the bill includes that part of the Clyde Valley extending about ten miles on each side of the river and about twenty miles up and down stream from Glasgow. The area covered is about 700 square miles, and three generating stations will be erected to meet the demand for power. The scheme has been promoted by a group of manufacturers who desire to obtain cheap electrical power and who realize that this can be better done by joining in a common system than by each putting down his own generating plant.

This is the busiest part of industrial Scotland and contains about 1,200 works, many of which are large iron and steel works, coal mines, shipbuilding yards and chemical works. Some of these works will alone require more power than many of the local municipalities now provide for lighting purposes, and it was easily shown that it would be inadvisable for the separate boroughs to attempt to supply an amount of power involving so large an expenditure of capital.

The three generating stations are to be built at Motherwell, Yoker and Crookston. The Motherwell station is located in the neighborhood of a large number of manufacturing works and in the centre of an extensive coal field and can be connected with the adjoining line of the Caledonia Railway. It is, also, in close proximity to the River Clyde, from which water for steam and condensing purposes can be obtained.

The Yoker station is also situated on the Clyde, near the line of the Lanarkshire & Dumbartonshire Railway, and is in close proximity to a large number of shipbuilding yards, works and docks. Authority has been obtained to lay cables across the Clyde from Yoker to Renfrew, which will enable the works at Renfrew, and other works on the south side of the river, to be supplied from this station.

The third generating station will be situated near Crookston on the Glasgow & Southwestern Railway canal line; but, owing to the arrangement allowing the company to cross the river, it will not be necessary to construct this station immediately.

The works from which the most urgent demands for power have been received are situated in the areas immediately surrounding the first two sites and it is intended, therefore, to proceed with these stations first and to install in each a plant of about 4,500-kilowatt capacity. They will be so designed that they can be enlarged from time to time, as the demand requires. A radius of fourteen miles from these stations covers practically the whole district in which the company will be allowed to distribute its power, but a large proportion of the works are located within a radius of six or seven miles of the stations. When the stations are in operation, they will probably be coupled together electrically, enabling them to share the loads and average up their power-factors or to supplement or aid each other in any emergency. The capacities of the respective stations will ultimately be about 10,000 kilowatts each at Motherwell and Yoker, and 5,000 at Crookston. By utilizing cheap sites for the stations outside of towns and near to the coal mines, it will be possible to generate power at a very low cost. Of the 710 square miles covered by the scheme, only thirteen are at present supplied with electricity. It is said that over 300 manufacturers petitioned in favor of the proposition and it is thought that many of the remainder petitioned in favor of the rival Caledonian scheme which was turned down. The carrying out of this mammoth scheme of power distribution will place the manufacturers of Glasgow on a footing to be compared to that of American manufacturers who are so fortunate as to be within range of our cheap water powers.

The authorized capital of the Clyde Valley Electrical Power Company is $4,500,000, with borrowing powers of $1,500,000. The total cost for plant on the transmission lines is estimated at over $2,000,000. The electrical apparatus, which will comprise polyphase alternating-current generators and transformers for high-voltage power distribution, rotary converters for the supplying of direct current, etc., has been contracted for with the British Westinghouse Electric and Manufacturing Company. Messrs. Strain & Robertson are the engineers of the Clyde Valley Electrical Power Company. Mr. Robert Robertson has recently spent a considerable period in the United States investigating systems and methods of power transmission and distribution, particularly in large cities and in such localities as Niagara, Snoqualmie Falls, Wash., Canyon Ferry, Mont., and other places.

Notes from Great Britain.

(By Our Special Correspondent.)

THE question of technical education, especially in relation to the training of engineers, has been receiving a large amount of attention recently in Great Britain. National supremacy in any sphere almost solely depends upon the education of the future leaders in that sphere, and those at present discoursing upon the training of engineers are doing their best to emphasize the point that the general public are much too prone to place undue reliance in the anticipated after results of the technical training meted out at the polytechnics or workingmen's colleges, with which London alone is now equipped with a quantity bordering on the abnormal. At the British Association at Belfast this year a highly abstract and academic discussion took place upon this matter which was heralded by Professor Perry's presidential address to the educational section, who viewed the system adopted by the city and guilds of the London Technical Institute with favor, a system which has certainly been most successful if one may judge by the number and importance of the posts in the electrical engineering world held by past students of this institute. The opening of the largest technical schools in the United Kingdom, *i. e.*, at Manchester, took place recently, the opening function of which was performed by no less a person than the Premier of Great Britain, the Right Hon. A. J. Balfour. In the electric supply station of these schools are four 100-kilowatt machines and one 50-kilowatt dynamo, this latter being a Parsons turbo-electric generator. Among the other details of an up-to-date equipment are a couple of electric passenger lifts available alike for traffic and for experimental purposes. Another feature of the equipment is an experimental tram-car truck in the dynamo room fitted with Messrs. Dick, Kerr & Company's continuous-current motors. Underneath the truck is a pit, and altogether it is said that a complete series of tests can be carried out under conditions approximating as nearly as possible to actual working conditions. The whole outfit, of which these few items are but a tithe, is so complete that the following list of tests of an electrical nature has been drawn up as a guide to manufacturing firms wishing to avail themselves of the facilities thus afforded—complete tests on dynamos, meters, transformers, starting resistances, switches and appliances for continuous, alternating and polyphase plant at high or low tensions; calibration of voltmeters, ammeters, wattmeters and current meters; tests for insulation resistance on all kinds of insulating materials, cables, etc.; photometric and efficiency tests of electric lamps of all kinds; complete tests of heating appliances, secondary cells, electric furnace work, and general, electric and chemical engineering; verification of standards of current; electromotive force, capacity, etc.; testing of all materials and appliances for electric traction work; testing and repairing of experimental electric appliances.

Two little matters concerning the British Post Office are worthy of mention. One is that, finding the electric motor mail-van service between the General Post Office and one or two of the London railway termini so satisfactory, further extended trials are to be accorded this type of vehicle over a much more hilly portion of the London postal area, and the builders of the first mail van have been ordered to supply the next one. The other matter in question is a report that the Postmaster-General has, upon information received from the Italian postal authorities, requested Count Foeggi to visit him in London at an early date. It may possibly be known that this gentleman has invented a system of delivering letters between towns in which he uses a sort of system of telpherage which is very favorably looked upon in Italy. Whether Count Foeggi is actually going to visit London, however, is not known.

The Strowger automatic telephone exchange, an attempt to introduce which was made some few years ago but with no success, has again made its appearance in London, and the gentlemen in charge appear to be using somewhat more active measures this time, judging by the way the daily press has got hold of it.

In connection with its tramways contracts the London County Council is working on rather unusual lines as regards the road work. It is placing the contractors under a penalty of $5,000 for every week occupied over the specified time, but in a spirit of fairness is guaranteeing a present of a similar sum of money for every week under the contract time in which the work is finished.

Of the numerous American business houses which are now building works on British soil, the British Thomson-Houston Company is the first to get its into working order, and at the end of October a press view was given. As a matter of fact the works are not working at their full output yet, although the majority of the buildings are completed and some 800 work-people employed. The site is some twenty-five and one-half acres in extent, situated at Rugby on the Midlands, but of this area only ten acres are at present utilized. The various buildings number fourteen, built of steel and brick and somewhat isolated from each other in order to avoid fire risks. The power-house contains two 200-kilowatt, 550-volt continuous-current sets and one 100-kilowatt set at the same voltage. This latter is direct-coupled to a Browett-Lindley horizontal compound-tandem engine running at 235 revolutions per minute, the two larger sets being direct-coupled to Cole, Marchent & Morley horizontal, tandem-compound Corliss type engines running at 120 revolutions per minute. A Wheeler "admiralty" type of condenser is employed, which has 1,200 square feet of cooling surface, with combined steam-driven air and circulating pumps. In the boiler house are two Babcock & Wilcox boilers, each with 2,530 square feet of heating surface, fitted with superheaters, the working pressure being 160 pounds per square inch. A steel chimney has been erected, lined with brick, coal being conveyed directly into the boiler house, and the ashes brought out by means of an elevator and emptied into trucks. For the purposes of the testing department, the switchboard is equipped with a duplicate set of bus-bars. The lighting mains are run off the same bus-bars as the motor connections. Various systems of lighting are employed, including incandescent and enclosed arcs. The work at present carried on here includes motors and tramway equipments, the large generators and alternators still being sent over from America. The Westinghouse company is also well forward with the construction of its new works at Trafford Park, Manchester, and it is to be hoped that British manufacturers will not shut their eyes to the increased facilities such works will

give to the particular firms when the question of quick delivery is important.

A delay has occurred in connection with the much-talked-of London to Brussels telephone line which was not anticipated. The defect arose some time ago after several miles had been laid, and it is not now expected that the line will be open for traffic until some time during the first few months of next year instead of this month, as originally intended. The entire work has been carried out under the jurisdiction of the British Post Office authorities by the two cable steamers Alert and Monarch. The cable is said to be the longest of its kind in existence, and has cost some $400,000, of which England and Belgium will pay half each. The charge will probably be eight shillings or ten francs for three minutes' conversation. In connection with cable steamers, I notice that a new twin-screw, cable-repairing steamer has just been launched at Paisley, Scotland, built to the order of the Canadian Government, and named the Lady Laurier. It is intended for service on the Atlantic Coast in the place of the Newfield, which was wrecked off Newfoundland in 1900. It has a speed of fourteen knots and is fitted with the latest type of picking-up and paying-out gear.

A royal commission has been appointed to enquire into the use of electricity in mines and the dangers attending it, and a report will be made as to what measures should be adopted in the interests of safety by the establishment of special rules or otherwise. It includes Mr. James Swinburne, president of the Institution of Electrical Engineers, and some of his Majesty's inspectors of mines. Up to the present the application of electricity in mines has been absolutely free from any special legislative control, and some such action on the part of the government as this was prophesied last year by Mr. A. P. Trotter, the electrical adviser to the Board of Trade, during the discussion upon a paper before the Institution of Electrical Engineers dealing with this subject. Having in mind the admittedly crude nature of the electrical equipments of some mines in Great Britain, and in many instances the absence of any skilled superintendence, we may be deemed fortunate that no very serious accidents have occurred hitherto. Happily the practice in this respect recently has greatly improved, and it is to be hoped that the result of the committee's labors will be the evolution of some regulations which will lead to greater standardization than heretofore, to say nothing of the safety point of view.

One thing which Great Britain is noted for, and which is often urged against us as a reason for a certain backwardness one hears a good deal of at times, is the absence of overhead wires for power purposes, thus increasing the cost of transmission. This is a matter over which the Board of Trade has full control, and it is often overlooked that in certain instances the Board may, and does, give permission to use overhead wires, provided satisfactory proof is given to their safety. A recent instance of this action on its part has occurred at St. Helens, Lancashire, where overhead wires at 500 volts have been sanctioned for supplying some chemical works. The conditions imposed provide for the erection being carried out in a proper manner and that they should be kept under constant inspection.

South Lancashire is still so continuing to lead the way in traction matters that on the system of the South Lancashire Electric Traction Company, which now runs the longest "through" tramway route in the Kingdom, wayside waiting rooms have been erected, a thing far in advance of anything yet attempted here. There is also a system of signaling adopted on these tramways, which on many parts of its route can be more aptly termed street railways. Almost every week one sees the indirect effect of the increasing mileage of electric tramways in Great Britain, and the latest "development" is the decision of the Lancashire & Yorkshire (steam) Railway Company to adopt electric traction upon one section of its line experimentally. The company has been carrying out its investigations very quietly during the past twelve months, and has got so far as having selected the contractors for that portion of the work in question which it does not propose to carry out itself. Bearing upon the same subject, also, Londoners may view with pleasure the fact that the contractors for the rolling stock of the Great Northern & City (tube) Railway have commenced delivery. Seven coaches have been sent off from the works out of the fifty ordered. Each of these seats seventy-three passengers, and has cost approximately $5,000. This line, it will be remembered, is the only tube line as yet constructed or sanctioned which has a tunnel sufficiently large to accommodate the rolling stock of existing steam railways. The *contretemps* between Messrs. Morgan and the London United Tramways Company is gradually dying a natural death, and ere long we shall be overwhelmed with the proposals for the next Parliamentary session, as bills have to be lodged before the end of this month.

It is stated that the International Wireless Telegraph Congress will take place in Berlin at the end of March or the beginning of April, 1903, and that England, the United States, France, Italy, Austria-Hungary and Russia have responded to Germany's initiative in a most friendly spirit.

Quite a sensation has been caused in municipal circles, as well as elsewhere, at the sudden change of policy on the part of the Tunbridge Wells corporation concerning its telephone exchange system. It will probably be remembered in America that this was the first municipal system to be started up in Great Britain after the passing of the new telephone act in 1899, and so far nothing had happened to foreshadow the latest turn of events, *viz.*, a decision to sell out the system to the National Telephone Company. But this decision has to be ratified by the Postmaster-General before any agreement between the two parties can be ratified, as there is a clause to this effect in the agreement between the corporation and the government. Whatever the terms of the agreement between the National company and the Tunbridge Wells corporation, all this is a bad blow for municipal trading, albeit Tunbridge Wells can hardly be looked to as a fair example of what a municipality could do with a telephone system in competition with the National company. Glasgow is hardly likely to throw up the sponge so quickly.

A somewhat minor installation of wireless telegraphy on the Marconi system in London, of which few of the general public here are even aware, is in use by the London Fire Brigade for communication between several of its south London stations. It has now been in use for two years, and a decision has recently been made to continue its operation at an increased rental.

With the conclusion of the war in South Africa a large amount of industrial business is being transacted, especially on the electrical side, and so far British firms have nothing to complain of as regards the destination of the orders. Ladysmith, Durban and other large centres have each ordered machinery through the agents of British firms, although this may be partly due to a preference for these goods rather than any extra business pressure displayed on the spot. At the present moment the Durban corporation is advertising for tenders for a 7,200-line telephone exchange, and the Bulawayo municipality for a tramway system. A. W.

London, December 1.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Thermit Welding for Tramways.

In this article Mr. C. E. Masterman describes the thermit process as applied in Berlin. Thermit is a mixture of aluminum and oxide of iron, mixed in chemical proportions. When a small portion of this mixture is raised to a temperature exceeding that of melted iron, the aluminum reduces the iron and raises the mixture to a very high temperature. If this mixture is allowed to come in contact with iron it melts it away, and to prevent this action, when used in welding, it has been necessary to reduce the temperature of the mixture by adding to it about fifteen per cent of wrought iron in small pieces. Rails to be welded are enclosed in a kind of mould, into which this mixture is poured. After a few moments the rails are raised to the welding point and the molten iron unites them, forming a perfect joint. If desired, the rails can be forced together by suitable clamps, in this way making a butt weld. Details of the crucible are given, showing how the molten iron is poured into the mould before the aluminum slag, as the latter would prevent a good joint from being made. It is stated that in three minutes after igniting the mixture the joint is complete.—*Tramway and Railway World* (London), November 13.

Production of Metallic Calcium.

Borchers and Stockem have described briefly a method for producing metallic calcium by electrolysis. In this article K. Arndt describes what is claimed to be a simple method of accomplishing the same result. He covers an iron crucible on the inside with a fire clay mixed into a plastic mass with water. This is placed in an oven and heated for twenty-four hours. A carbon rod used as anode and a thick iron wire covered by a porcelain tube, except at the lower end, serves as a cathode. To prevent excessive heating, the crucible is placed on a large iron block. An arc is used for melting the anhydrous calcium chloride. This is established between the anode and cathode by an iron rod held in the hand and connected to the negative pole. The rod is drawn from the carbon rod until the current passes through the bath. The current strength used was from twenty to twenty-five amperes, and the mass remained in a quiet fluid condition. After cooling the metallic calcium was secured in large pieces which were ductile and easily filed. In a fresh crucible the metal is quite white, but quickly becomes yellow. Analysis showed that the mass contained ninety-nine per cent of calcium and one per cent of silicon. Iron and aluminum were not found.—*Zeitschrift für Elektrochemie* (Breslau), November 13.

Electric Railways.

At a recent meeting of the British Institution of Civil Engineers, Messrs. C. Hopkinson, E. Hopkinson and E. Talbot presented a paper on electric tramways, of which this article is an abstract. The subject was considered under the following heads: The generation of power, transmission of power to the cars, rolling stock and earth returns. The nature of the load on a tramway generating station was discussed, and it was shown from actual records to what extent increasing the number of cars resulted in making the load more uniform. With seventy cars, or more, the load was so nearly constant that the steam consumption per unit was substantially the same as though it were constant and equal to the mean. Hence in a station of this size there was no necessity for a storage battery to equalize the load. However, it was thought advisable that a battery equal to one-third of the generating plant for one-half hour should be installed in a continuous-current power station for the purpose of replacing a generating unit in case of a breakdown and for running cars at night. The effect of short-circuits on the generator was considered, and it was shown that in the worst cases there might be a force three times as great as the normal force applied at the periphery of the armature for a period of one-tenth of a second. This necessitates very strong construction between the armature and flywheel. Although the simplest method of transmitting power to the cars was to make the trolley wire an electrically continuous network, in practice it was found necessary to divide the system into sections, insulated from each other. The points of division in cities were determined by considerations of safety, in outlying districts by questions of economy. The most economical size of cable was considered. The mean current density should but rarely exceed 300 amperes to the square inch. This entailed a mean drop of potential of about thirteen volts per mile of feeder. Feeders could be carried to a distance of one mile or one and one-half miles without boosting. The loss in the trolley wires supplying ten cars on one mile double track from one end was between two and four per cent. The use of the booster was then considered, particularly in reference to excessive traffic for a short time on one route. The chief requirements of the motor car for city work were that it should be capable of rapid and well-sustained acceleration and that it should be able to go uphill quickly. These requirements could be fulfilled only by motors capable of traveling on the level at speeds far above what was allowable in practice. It is stated that a mean acceleration of three feet per second could be obtained satisfactorily. Under the head of earth returns the actual resistance as determined by the authors for various rails and bonds was given. The use of special construction, such as the Falk welded joint and the Thermit welded joint, was discussed. It is inadvisable to use such joints on sharp curves or crossing bridges. On straight track, however, the lateral support of the rails prevented variations of temperature from doing damage. The paper concludes with a discussion of the means of complying with the Board of Trade regulations as regards the allowable voltage dropped in earth returns.—*Engineering* (London), November 21.

The Manchester and Liverpool Electric Express Company.

Work has been begun on the Manchester and Liverpool electric railway, and in this article the plans proposed are fully described. The road is thirty-four and one-half miles in length and over this cars are to be operated on a ten-minute headway at a speed of 110 miles per hour. The line laid out for the road is fairly straight; the only curves of importance being those by which approaches are made to the cities. Various gradients are met with, the steepest of these being one in twenty-five. There will be a steep gradient of one in thirty extending for nearly

1,200 yards in approaching the terminals of the road. These are for the purpose of assisting in the starting and stopping of the trains. The permanent way will be constructed on the monorail system. A succession of trestles will rest on ordinary wood railway sleepers, nine feet long and, in general, three feet from centre to centre. These trestles will support the monorail about four feet above the surface of the sleeper. On each side of the trestles there will be two guiding rails. Cars will be operated over this road singly, as coupling at such high speed is not thought advisable. Each car will be supported on four vertical wheels running on the central rail and will be prevented from excessive lateral or vertical motion by the guide-wheels. Each car will be provided with four continuous-current motors, driving, by means of chains, two of the four vertical wheels. The motors are arranged in pairs and fixed low down so as to keep the centre of gravity of the car low. These motors will have a normal capacity of 160 horse-power each. Power for the load will be generated at a station to be erected at Warrington, which is half-way between Manchester and Liverpool. The current will be generated at 15,000 volts, three-phase. Five substations will be erected along the line at which the current will be transformed into continuous current at 650 volts. This current will be supplied to the cars by means of two conducting rails, one being placed on each side of the trestles. Special consideration has been given to the question of braking. In addition to the working brakes the motors are arranged for electric braking. An electrical system of signaling, largely automatic, will be installed, which will operate the semaphores when a car passes the signal station. Elaborate terminal stations at the two cities are proposed. The road will enter these cities about sixty feet above the ground.—*Tramway and Railway World* (London), November 13.

Electric Railway Signals.

The London & Northwestern Railway, England, has had a system under test at Crewe the past three years by which its switches and signals were operated electrically. This system was invented by Mr. F. D. Webb, mechanical engineer for the railway, and Mr. A. M. Thompson, signaling superintendent. Five stations have been equipped, the largest of which contains 150 levers. The switches and signals are operated by drawing over these hand levers, and in this way completing a circuit which conveys power to the motor by which the switch, or the semaphore arm, is moved. The operating mechanism may be an electric motor or an electromagnet. The electromagnet operates directly, throwing the switch, or the signal arm, into the correct position, and this system has worked satisfactorily. The rotating motor operates through a worm, and a worm-wheel armature is on a shaft which runs in ball bearings. The worm is on a loose cross-shaft, and motion is communicated to this by means of right and left-hand clutches, the motor running continually. In operating either of these systems the lever arm is drawn over partially. This throws the motor into operation and locks the lever in that position until the switch has been moved. When the switch has reached its final position it releases the lever which can then be thrown all the way over and set the signal properly. The system is more easily operated than mechanical systems, one man replacing two required by the latter system. As the wires can be placed underground the roadway is left much freer than when wires and rods must be carried over the surface. The railway company intends also testing a system of which the motive power used is compressed carbonic acid gas. The gas is contained in a cylinder at a pressure of 600 pounds per square inch, which is reduced to fifty pounds working pressure and admitted to the operating cylinders. The valves are operated electrically. For the electric automatic signaling it is claimed that it presents the block system in perfection by supplanting human intelligence by exact mechanism. It increases the capacity of a railway by enabling sections to be shortened without the expense of erecting additional signal boxes.—*Electrical Engineer* (London), November 21.

Electrical Testing of Dynamos and Motors.

This is the second section of a serial by Mr. C. F. Smith, and takes up the measurement of armature resistance by the potentiometer. This method is advised since armature resistances are usually small, and a potentiometer is more accurate than a Wheatstone bridge. The method is described in detail and precautions given for obtaining good results. For very large armatures, where the resistance is exceedingly small, the use of the Thompson double bridge is advised. In this method the armature is interposed between two arms of the Wheatstone bridge, while between the other two a low known resistance is inserted. The battery circuit is connected from one brush of the dynamo to one terminal of the known resistance, and a wire connects the other brush of the machine to the other end of the resistance. In this method of measurement, neither the resistance of the leads from the armature and the bridge nor variations of voltage of the battery produce sensible effect on the readings. In practice it is usual to mount a galvanometer and bridge some distance from the machine. In measuring the resistance of a newly completed armature, it is advisable to test from segment to adjacent segment all around the commutator, as well as for the resistance between every pair of opposite segments. In measuring the field windings, the series field resistance may be obtained by any other methods suitable for armature resistance measurement. The shunt windings, having a higher resistance, can be measured by either the voltmeter method or by a Wheatstone bridge. In these determinations it is necessary to close the battery circuit before closing the galvanometer key, as field circuits have a large inductance. The author next takes up the question of temperature measurements and explains the method of obtaining these by determining the change in resistance. He shows graphically that temperatures, as determined by thermometers, not only do not agree with those found from resistance measurements, but vary among themselves, depending upon the location of the thermometer. In a case cited, the temperature as indicated by resistance measurements was five degrees higher than obtained by a thermometer. As the former reading gives a mean value, it is probable that the maximum temperature of the winding was at least ten degrees higher than that indicated by the thermometer. Attention is called to the fact that temperature readings will be affected by the motion of the armature, as this tends to increase the ventilation. The hottest layer in a field coil is about one-quarter the depth of the winding from the inner layer. The author then discusses the use of mercury thermometers, and shows that readings obtained by the use of these are subject to great error. In a case cited, two thermometer bulbs were covered with cotton wool and a constant potential was applied to the magnetic windings. One of the thermometers was placed between the poles of the machine, while the other was placed on the outside. Results showed that a difference of twenty-one degrees existed at the final readings. The method

of using a testing coil for determining temperatures at different points of the windings is then explained, and it is stated that a coil of platinum wire, having a resistance of about ten ohms, was well suited for this purpose.—*Mechanical Engineer* (London), November 15.

Electric Railway of the Compagnie d'Orleans.

In this article, M. A. Delasalle gives a description of the Paris terminals of the Compagnie d'Orleans. When the necessity of securing a terminus near the centre of Paris was recognized, the charter and property for this were obtained and an underground road was decided upon. This made it impossible to use steam locomotives, so that electricity was decided upon. A commission was sent to the United States to study railway methods there, and tests were made at the works of the General Electric Company, which demonstrated the feasibility of the use of electric locomotives for this work. The length of the line is about four kilometres, of which 650 metres are open, and the rest is tunnel construction. The greatest grade is 1.11 per cent. The central station produces current for traction and for light, and is placed at Ivry. The current is transmitted at 5,500 volts, three-phase. At the substations it is transformed into direct current by means of step-down transformers and synchronous converters. The boiler room contains eight Babcock & Wilcox multitubular boilers, each having a heating surface of 186 square metres. A Green economizer has been installed with a heating surface of 400 square metres. The boilers can furnish 2,200 kilogrammes of steam per hour at a pressure of thirteen kilogrammes. The generator room contains two generating units which have an output of 1,000 kilowatts each. Each unit consists of a Dujardin steam engine directly connected to Thomson-Houston three-phase generators. The engines are triple expansion and have four cylinders. The dynamos have a speed of seventy-five turns per minute and generate a potential of 5,500 at a frequency of twenty-five cycles per second. Their efficiency is given as 92.5 per cent at half load, and ninety-five per cent at full load. For excitation two motor-generator units have been installed. The switchboard is divided into two sections—one takes care of the alternators and the feeders for the railway substation, the other controls the distribution of current for lighting. There are two substations, one at the Gare d'Austerlitz and the other at Quai d'Orsay. These contain the similar apparatus and distribute current both for light and for traction. Each substation contains six static transformers of ninety kilowatts, each reducing the tension from 5,500 volts to 350 volts; two synchronous converters of 250 kilowatts, and a battery of accumulators with a capacity of 1,100 ampere-hours. The track for the railway is standard construction with the addition of a light third rail for collecting the current. Within the tunnel the third rail is replaced by an overhead trolley. Each locomotive has a weight of forty-five tons, its length is nine metres and its total height 3.4 metres. The wheel base of each truck is 2.25 metres. The distance between the centres of the trucks is 4.75 metres. Each locomotive has one 125-kilowatt motor on each axle. These are Thomson-Houston motors, and are attached to the axle through gears. Their efficiency, including the gear losses, is eighty-six per cent. Each locomotive can draw a train of 300 tons at a speed of thirty-five kilometres per hour. The motors are coupled in pairs and the two pairs connected for parallel control. This road has been in operation for some time and has given entire satisfaction.—*Review Pratique de l'Electricity* (Paris), November 5.

Three-Phase Motors with Wide Range of Speed Variation.

As far back as 1893 the Oerlikon Company built three-phase motors in which the speed could be changed by varying the number of poles of the motor by a simple change-over switch. This article, by Dr. H. Behn Eschenburg, gives a brief description of these motors and passes to a more detailed description of a later type motor brought out by the same company. In the early motors, two speeds were provided in the ratio one to two. The primary winding is divided into six groups of coils, if the change is to be from two poles to four, and in twelve groups for a chance four to eight volts, a Gramme ring winding being used. In recent years drum windings have been adopted in general, but with this type of winding the above arrangement did not seem suitable. For this reason motors having two speeds were constructed with two primary windings, the throw-over switch connecting one or other of these to the circuit. This arrangement had the advantage of leaving the choice with the number of poles quite open. In cases where the torque varies with the speed, the winding for lower speed could be lighter than that for the higher speed. Recently the Oerlikon Company has adopted a type of drum winding which allows the number of poles to be changed in a manner similar to that used with the Gramme ring winding. The disadvantage of the drum winding, when used for this purpose, lies in the large leakage which takes place at one of the speeds. By a suitable selection of the pitch of the coils this fault has been overcome and the motors can be made to operate equally well at either speed. The several groups of coils are connected in mesh so that the motor having two speeds will have but six terminals. To give the motor two additional speeds a separate winding is placed on the primary. In this case the motor having four speeds will have twelve terminals carried to the switch. In starting one of these motors the switch is thrown to give the lowest speed, and is then changed until the desired speed is reached. As this reduces the starting current over what it would be if the motor were started with the switch in any other position, a considerable economy is claimed, and it was suggested that these motors can be used to advantage for electric traction. It is stated that the efficiency of this method of starting motors is equal to that of the series parallel control for continuous-current motors. A description of one of these motors is given. This has an output of eight horse-power and weighs 220 kilogrammes. The efficiency at full load is as follows: Seventy-two per cent at 500 revolutions; seventy-three per cent at 750 revolutions; eighty-five per cent at 1,000 revolutions; eighty-six per cent at 1,500 revolutions. The power-factor is 0.7 at the lowest speed and increases to 0.92 at the highest. The starting current for the lowest speed is fifty amperes, giving 5.5 kilogramme-metres starting torque. This company also builds a line of variable speed direct-current motors in which the changes in speed are obtained by field variation. To avoid sparking at the higher speeds a series-compensating coil is placed in slots in the pole-pieces. It is stated that the three-phase motors work with approximately the same magnetic flux in the air-gap at all speeds, and so can have a greater load and a better efficiency at the higher speeds, while the continuous-current motor can only increase in speed through the reduction in the magnetic field so that no increase in load or efficiency is possible.—*The Electrician* (London), November 21.

A Vera Cruz-Frontera-Campeche Cable for the Mexican Government.

Of the sum total of roughly 200,000 miles of submarine cable laid across the oceans of the globe, by far the greatest share has been made and laid by Great Britain. In recent years the strategic advantages of submarine cables in case of international disputes have been clearly exhibited, and the manufacture of cable has been taken up, to some extent, in France, Germany and Italy. Within the last few years submarine cable has been manufactured by industrial corporations in the United States. In particular, the Safety Insulated Wire and Cable Company has made about 2,000 miles of cable for the United States Government, which the government has laid, with a cable ship of its own, among the Philippine Islands.

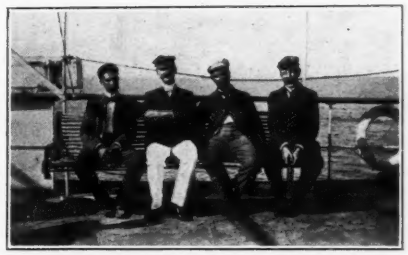
This year, however, a contract was taken by the Safety Insulated Wire and Cable Company, in competition with European manufacturers, to make and lay a cable under specifications from the Mexican Government Telegraph Department to connect the ports of Vera Cruz, Frontera and Campeche, in the Gulf of Mexico. The contract length of this cable was 472 nautical miles, or 544 statute miles. This cable has recently been made and laid, and since it is the first cable made in America for foreign owners, and also the first cable of any considerable length laid by an American cable company, the story of its manufacture, shipment and delivery on the selected sea bottom route will be of interest.

The contract for the cable was secured by Mr. Ira W. Henry, vice-president of the Safety company, who also drew the engineering specifications for its manufacture. The contract specified the nature and length of the cable, the details of its parts, in relation to sizes, qualities and tests, the equipment of the cable houses or terminal buildings which the company was to erect, the depths of water in which the cable was to be laid, and many other particulars.

The cable was manufactured at the Safety company's works at Bayonne, N. J., on the water front of New York Bay, where the company has a complete and modern submarine cable factory, with the latest designed foreign and American equipment, from machinery for preparing the raw rubber gum to tanks in which to coil the finished cable and a wharf from which to deliver it. The total manufacturing capacity of the submarine cable department is about twenty nautical miles of cable daily. Inasmuch as the details of size and construction differ considerably in different cables, according to the depth of ocean, topographical conditions and the views of the engineers who draw up the specifications, the particular process of manufacture to be described applies in detail only to the Mexican Gulf cable here considered.

The electric conductor of the cable consists of a strand of nine tinned copper wires—eight wires of the same size spiraled about a larger central wire. A stranded conductor is not only more flexible than a single-wired conductor, but is also less liable to accidental discontinuity by rupture.

The stranded conductor is run, in mile lengths, through a machine which lays on a thin, seamless coating of pure rubber gum. This gives the first insulating coating. The strand thus coated then passes through a second machine, in which it receives a thicker seamless coating of vulcanizable rubber, or a material containing



OFFICIALS OF THE EXPEDITION.

Capt. D. Almedo, E. E., Mexican Government. Mr. Ira W. Henry, Vice-President Safety Co. Sr. A. Parra, Inspector General Mexican Telegraph Dr. A. E. Kennelly, Professor Electrical Engineering, Harvard University.

over forty per cent of rubber. This completes the insulating covering, and the conducting strand has then been converted into rubber core. The core is vulcanized in its outer coating by immersion in a hot bath for a suitable time. The finished core is then taped and joined together in five-mile lengths. This rubber core will stand knotting, scraping and rubbing remarkably well.

The five-mile lengths of core are then subjected to 5,000 volts of alternating-current pressure for five minutes, to make sure that the core contains no cracks or incipient defects. It is also tested for insulation by battery, and for capacity and conductor resistance. After undergoing these tests while immersed in water, the core is ready for being converted into cable by the process of armoring. An armoring machine consists essentially of a long series of vertical revolving discs carrying spindles. The discs are separated by troughs. The core passes through the series of discs through central apertures, and through the troughs between them, receiving from the spindles at each disc a layer, in spiral form, either of jute or tape or steel wire. In the troughs it receives coatings of compound of tarry character and appearance. On entering the machine, the core passes through the centre of two discs in succession, and receives two layers of jute, laid on in opposite directions. Then it passes through the centre of a disc which lays on sixteen steel wires, each galvanized, compounded and taped. The next two discs apply more servings of jute in opposite directions, after which the cable receives a coating of preservative compound, and a final coating of talcum to make its surface non-adhesive. Thus the core, steadily entering the machine at one end, comes out as continuous finished cable at the other, ready for shipment or coiling away in steel tanks, where it can be kept and tested under water. The dielectric strength of the insulator is tested by the application of 1,000 volts of direct-current pressure, and the usual insulation, capacity and conductor resistance tests are applied by battery.

As each of the sixteen armor wires will withstand about 1,000 pounds pull before breaking, the breaking stress of the cable is in the neighborhood of eight tons. This is with the deep-sea cable, for laying in relatively deep water. Near the shore and in shallower water, a heavy cable is used, or a "shore-end type." This shore-end cable is made by passing deep-sea cable through another armoring machine, where it receives an external sheathing of eighteen galvanized steel wires, as well as external servings of jute and compound. The breaking stress of the shore-end cable is thus raised to about twenty tons. The shore-end cable has a diameter of about one and two-thirds inches and weighs six and one-half long tons to the nautical mile, in air. The deep-sea cable, or lighter cable, has a diameter of about one and one-ninth inches and weighs two and one-half long tons per nautical mile.

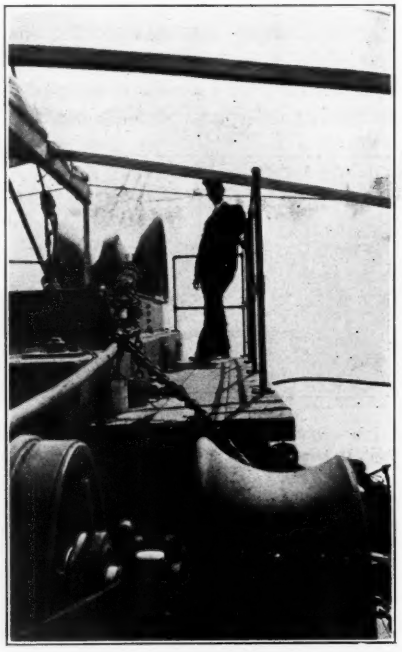
As the Safety company did not possess a cable ship of its own with which to lay the cable, it was necessary to charter a vessel for this purpose. There was considerable difficulty in securing a suitable vessel. The total weight of the cable was 1,500 short tons, and its total coiling space was less than 28,000 cubic feet. The cargo space available on an ordinary steamer of 1,500 tons' carrying capacity is, commonly, 80,000 cubic feet, or nearly three times more than the cable would occupy. But in the ordinary cargo steamer the space is arranged in such a

manner that but little of it is available for stowing cable. In order to pay out safely, the cable must be coiled away in large tanks, nearly the breadth of the ship in diameter, and these must be open cylinders from the top to the bottom, whereas the ordinary ship has "between decks" that are continuous fore and aft, except for relatively small hatches. Enlarging these hatches sufficiently to allow the tanks to be erected involves cutting steel beams, stringers, diagonals and hatch combings, at considerable expense to remove and subsequently restore. If no deck cutting is attempted, then it would probably require a 10,000-ton ship to receive the 1,500 tons of cable.

After a number of vessels had been examined with a view to equipment as cable ships, without success, it secured, under contract, the steamship Ydun (Captain Christiansen); the construction of this ship was well adapted to the purpose. This vessel had no between deck, forward or aft; so that below her main deck she was built like a huge steel box. Consequently, in order to make room for the four cable tanks required it was only necessary to remove some vertical steel stanchions and compensate for their strength by some trusses and tie rods close to the under side of the deck. The steamer was 240 feet long, with a beam of twenty-five feet, and a carrying capacity of 2,000 tons.

The cable tanks were made of wooden crib cylinders. In each tank the crib was formed of a circular row of twelve-inch by eight-inch vertical timbers, two and one-half feet apart at their upper ends. These were supported laterally by ties between them and by other ties to the sides of the ship. They were also girdled by steel ropes, drawn tight by wedges, driven and nailed. In the centre of each tank a timber conical frame or cone was erected. Inaddition to the tanks, eight extra cabins had to be built below the bridge, to accommodate the cable-laying staff, and a testing room had also to be built. On deck, the large cable winch or picking-up-and-paying-out gear was erected. This carries a six-foot steel drum around which the cable passes either into or out of the ship. It has a double-horizontal engine to drive it when picking up at either of two speeds, while a brake is attached for use in paying out. This cable gear occupied seventeen feet by eleven feet of deck space. It was built to specifications by the Lidgerwood Manufacturing Company, and was the largest and strongest cable gear that has yet been built in America. Besides the gear, large bow sheaves had to be mounted over the stem, a smaller pair of sheaves at the stern, a dynamometer to indicate the tension on the cable and various guide sheaves to lead to and from the various tanks. This alteration and equipment were carried out at the Robbins Dry Docks, in Brooklyn, N. Y.

The electrical equipment of the vessel consisted of a small steam-driven dynamo for incandescent lighting, 400 cells of battery, two D'Arsonval marine reflecting galvanometers, rheostats, Wheatstone bridges, portable testing sets and a complete Morse signaling outfit. Nearly all of the electrical testing instruments were furnished by Messrs. Leeds & Company, of Philadelphia.



Bow Sheaves, with Cable in Stoppers.

The Ydun was handed over to the Safety company under charter, for the reception of cable in her tanks, at Brooklyn, on August 19. At this time lighters loaded with the cable from the Bayonne factory were waiting alongside, and the coiling of the cables from the lighters into two of the tanks commenced at once. All of the cable was coiled on board the ship by September 2, when General B. M. Whitlock, the president of the Safety company, paid a farewell visit to the ship. The vessel left Brooklyn with the cable, cable staff and crew, on September 3, bound for Vera Cruz. That port was reached safely and uneventfully on September 13. Here the ship was joined by the vice-president and representatives of the company, Mr. Ira W. Henry, who had in charge the diplomatic part of the expedition, accompanied by the Mexican Government officials, Messrs. A. Parra, inspector-general of the Mexican telegraphs, and Captain D. Almedo, engineer, with two assistants, who attended the laying of the cable on behalf of Senor Camile A. Gonzales, the director-general of the Mexican Government Telegraph Department.

The cable house for receiving the cable was landed in sections and erected in the adjoining bay north of Vera Cruz Harbor, well above high-water mark, and about two miles from the town. Arrangements were made to secure a lighter and steam launch to land the end on the beach. Two miles of shore-end cable were coiled in the lighter, and this was then towed by the launch round to the North Bay. The lighter anchored outside the surf in about four feet of water, near the beach, and with the aid of men, boats and mules, the end of the cable was hauled ashore and connected into the cable house. The steam launch then towed the lighter slowly seaward along the selected course, and the lighter paid out the two miles of cable as she went, buoying the sea end in ten fathoms of water, at a position where the ship could readily come in and reach it.

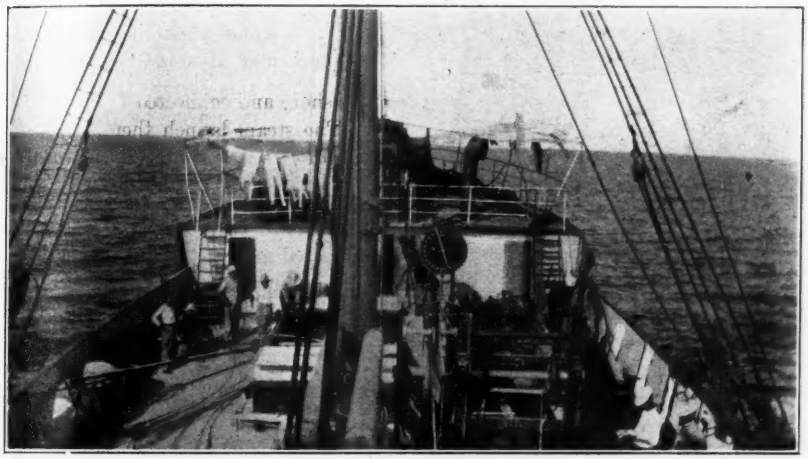
On the day following (September 18), the Ydun left Vera Cruz Harbor, and came round to the buoy over the sea end on the North Bay. The sea end was soon picked up, and after "speaking" and testing through the cable to the cable house the deep-sea cable in one of the tanks was spliced on. Shortly after sunset the splice was finished. The ship swung round on her course seaward, and commenced laying the cable toward Frontera, steering during that night by the bearings of the lighthouses in the neighborhood.

After steaming steadily for two days and nights at an average speed of nearly four knots, the ship arrived off Frontera, and came into water sufficiently shallow to call for a change from deep-sea to shore-end cable. Here the cable was cut and buoyed, about nine miles from Frontera Beach. Released from the cable, the ship steamed at full speed to Frontera, and anchored near the mouth of the River Tobasco.

Here the Frontera cable house was landed and speedily erected on a suitable site near the beach and lighthouse. With a steam launch and lighters, two short diverging shore ends were laid out from

the cable house, and their sea ends buoyed. The ship then picked up the western sea end, spliced on heavy cable to it, and paid out to the Vera Cruz end buoy nine miles out to sea. Reaching this buoy, the Vera Cruz end was picked up and found to be in good electrical condition. The cable paid out from the tank was then cut and spliced on to the Vera Cruz end, thus making the final splice, and completing communication between Vera Cruz and Frontera within thirteen days after first reaching Vera Cruz. The final tests of the cable, 234 nautical miles in length, were completed the same night from Frontera cable house.

After completing the shore end of the Campeche section, by laying it out to sea for a distance of eight miles from Frontera, the Ydun steamed directly to Campeche in order to lay the cable from the port back toward Frontera, and to make the final splice at the position of the shore-end buoy.



FORWARD DECK, SHOWING CABLE GEAR AND DYNAMOMETER.

Campeche is a difficult port to enter with cable owing to the shallowness of its waters. When the Ydun anchored off the town, in fifteen feet of water at low tide, she was eight miles from the wharf, and was scarcely visible from the beach. In order to avoid anchors in an expanse where all is anchorage, it was necessary to lay the cable in a considerable detour. Added to this, there was no steam launch to be had in the port, the last existing one having being blown up. There were also no lighters. In order to effect a landing, it was necessary to convert a sailing boat into a lighter by removing her mast, and to engage a schooner to act as tug. As the schooner could only tow the lighter when the wind was fair, it was necessary to await fair winds before towing the lighter in shore or laying out seaward. However, by taking advantage of each change of wind, the cable house was landed and the shore end buoyed seven miles out to sea at a position where the ship could reach it at high tide within six days after reaching Campeche.

On October 4 the ship spliced on to the shore end and commenced paying out cable toward Frontera.

Up to that time the weather had been favorable, but on the following day a change set in for the worse. After about 120 miles had been paid out, it was blowing a gale, and the ship could not keep her course. The cable was, therefore, cut and buoyed. Every hour brought more violent weather, until it was evident that the vessel was in a severe cyclone. In the early morning of October 7, the ship passed through the centre of the hurricane in a region of comparative calm wind but refused sea. Large numbers of land birds, varying in size from humming birds to large storks, alighted on the vessel at this time, having been caught in the centre of the hurricane and carried violently out to sea. After two hours' respite the storm again struck the vessel from the opposite direction, and continued with violence for the day following. Although struggling against the wind with all the steam power available, the steamer drifted very rapidly toward the shore. Fortunately the weather abated sufficiently when the ship was close to land to permit of the ship's holding her own, with both anchors out, and the engines going full ahead.

After laying at anchor for a day to let the storm go by, and to refit the ship, a run was made back to the position in which the cable had been cut and buoyed. The buoy, however, was nowhere to be discovered. Finally it was necessary to abandon further search for the buoy and to grapple for the cable. A grapnel was put down and the cable was hooked on the first drag. It was brought up to the surface on the afternoon of October 10, and the ship soon spliced it on to Campeche end, paying out then recommenced. On the following day the buoy on the end of the heavy Frontera section was reached, and the final splice let go. This completed the laying of both cables within thirty-eight days of the Ydun leaving New York Bay. On proceeding to Vera Cruz the cable was taken over by the Mexican Federal Telegraph Department and found to operate at a satisfactory hand speed by Morse system over the 450 miles from Campeche to Vera Cruz.

The entire engineering charge of the cable-laying expedition was given to Dr. A. E. Kennelly, professor of electrical engineering at Harvard University, who also served as inspector for the Mexican Government during the manufacture of the cable. With him were associated on the ship the Safety company's engineering staff, consisting of Mr. G. M. Haskell, chief electrician; Mr. William H. Rodier, cable superintendent; Messrs. R. O. Smith and Thomas Bayne, assistant electricians, and Messrs. John Lind and Julius Bernstein, assistant engineers. The navigation and management of the ship were carried out by Captain C. Christiansen.

Magnetic Declination Table and Isogonic Charts for 1902.

This is a special publication of the United States and geodetic survey. The principal facts relating to the earth's magnetism are here discussed, the subjects including the history of the compass, the discovery of the loadstone, improvement of the compass and voyages of discovery. The science of terrestrial magnetism is taken up and the various phenomena here discussed at length. Changes of the magnetic field are described as well as the methods for determining these. Methods of determining the true magnetic meridian and the magnetic declination, both by observation on Polaris and by observation on the sun, are explained. Complete charts of the United States for the year 1902 are given, with a table of the most recent magnetic declination observed in this country. The volume closes with a description of the magnetic stations occupied by the coast and geodetic survey between 1881 and 1902. The volume is fully illustrated.

New Telephone Apparatus—II.

Descriptions and Illustrations of the Latest Types of Telephone Instruments and Telephone Accessories.

Telephone Pay Station Service in the United States.

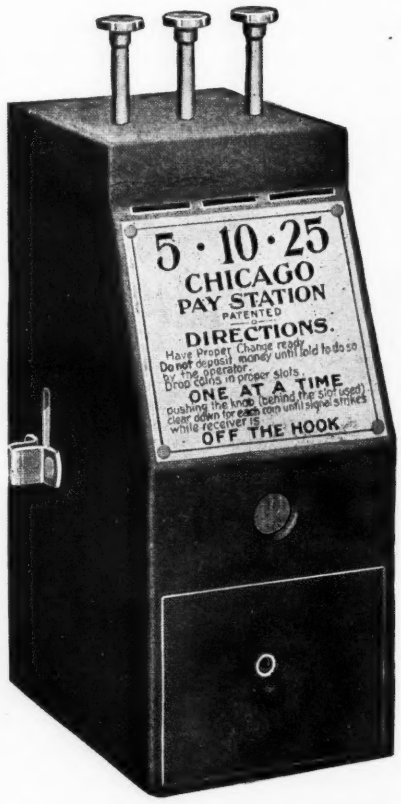
There are two classes of pay station service in the United States:

First—Public pay station offices, accessible to the public, established by telephone companies in convenient localities in charge of an employé whose duty it is to see that the patron receives the connection asked for and that the proper amount of money is charged and paid for such service, and that proper records are kept of each connection so as to enable the telephone company to determine the profit or loss resulting from each office. The receipts are credited to the office and the expenses of maintenance are charged against it. The reader can readily see that this is an expensive method of giving the public service, as rent of a suitable office and salary of an employé, to say nothing of minor expenses, are important items. However, there are a large number of these public pay station offices, being operated on a profitable basis throughout the United States, which are fitted up in a very attractive manner for the convenience of patrons during the time they are waiting for connection. Comfortable settees, tables, magazines and stationery add to the convenience of these offices and are among the things appreciated by the waiting public. There are but a few pay stations in proportion operated on this basis.

Second—It is safe to assume that nine-tenths of the number of pay stations in use throughout the United States are equipped with a coin-collecting device, of which there are several types, for the purpose of enabling the patron to use telephone and deposit the proper amount of money for service without any special attention on the part of a telephone attendant. One style used largely and which is growing more popular is that manufactured by the Chicago Pay Station Company, Chicago, Ill.

The Chicago "coin collector" is simply mechanical in its action and can be attached to any style of instrument manufactured at a minimum cost to the company, as it requires absolutely no wiring. This station is made with one, two and three-coin slots. For general purposes the three-coin slot type is preferable, as it is adapted to either local or long-distance rates. For instance, a party steps to a telephone coin collector, calls central in the usual way and asks for a person residing in the same city. The operator requests the patron to deposit the proper coin, which is done and the proper plunger pushed, in accordance with instructions noted on face of "coin collector." The pushing of the plunger actuates a hammer which in turn gives a peculiar signal audible to the telephone operator who knows immediately that the proper amount is deposited.

For a long-distance connection, the


5 · 10 · 25
CHICAGO
PAY STATION
PATENTED
DIRECTIONS.
Have Proper Change ready
Do not deposit money until told to do so by the operator.
Drop coins in proper slots
ONE AT A TIME
pushing the knob (behind the slot used) clear down for each coin until signal strikes while receiver is
OFF THE HOOK

PAY STATION TELEPHONE APPARATUS, FOR COINS OF THREE DENOMINATIONS.

patron, when requested by the operator, deposits the amount of the toll charge into the proper slots and pushes the plungers, thus giving clear and distinct signals to operator, who readily understands that the proper amount of money is deposited and that the subscriber is entitled to service.

These coin-collecting devices are placed in hotels, railway depots, city railway waiting rooms, drug stores, restaurants and, in fact, in every place accessible to the public.

A careful enquiry resulted in ascertaining that the average revenue received by one company that has thousands of pay boxes in use is $7.50 per month, the maximum receipts being very much larger, and in some cases about $200 per month.

This form of service has become so popular in the large cities of the United States during the past year that restaurants and hospitals are being equipped with portable sets which can be carried about by an attendant without the least difficulty.

A number of the steamboat ferries plying on San Francisco Bay are equipped with pay stations, so as to enable the passengers to talk to any point in the city during the time that the boat is at wharf, by means of a temporary trunking circuit with central office which is made when the boat arrives at the dock and disconnected prior to leaving. That this service is appreciated by the public is proven by the revenue resulting from its adoption, which is very encouraging. It is safe to assume that the growth of the pay station business during the past twelve months will be surpassed in the future, as numbers of large companies throughout the country are about to adopt this service very extensively.

A New Telephone Switchboard Lamp.

A new type of switchboard lamp, for use without a base, is being manufactured by H. Boehm & Company, makers of miniature lamps, 334 East Federal street, Youngstown, Ohio. By reason of its being used without a base, the lamp is claimed to be much smaller than is ordinary with this type of lamp. The lamp slips into the socket, and the springs within the socket clamp the lamp on

SOCKETLESS SWITCHBOARD LAMP.

either side against the contacts. These contacts are shown in the accompanying illustration by the darkened portion. Connection is made in this manner. The lamps are one and one-eighth inches in length and operate with great satisfaction.

A New Hook-Switch.

The hook shown in the accompanying illustrations is of the long lever type, mounted on a heavy brass frame fastened with a bolt and nut. The hook lever forms no part of the circuit, but all contacts are made by the springs mounted upon the lug on the side of the frame, as shown. The downward movement of the hook causes the hard rubber insulated pin attached to the lever to be drawn in between the springs, thus disengaging the springs and breaking contact as shown in Fig. 2, and making contact, as shown at Fig. 1, when the hook is released.

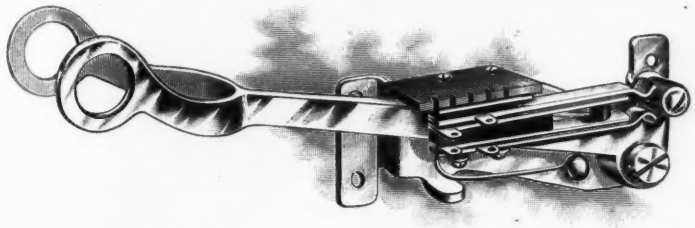


FIG. 1.—THE LEVER, MAKING CONTACT.

A stop is provided at the lower edge of the frame to prevent the downward movement of the lever below the proper point. The springs are made of German silver, of good length, and all contacts are of pure platinum. Pure hard rubber strips are used to insulate the springs from each other and the frame. At the top of the lug upon which the springs are mounted is fastened a strip of hard fibre with the front edge slotted, through which the wires are brought down to the springs, thus keeping them separated and reducing the chances of short-circuiting to a minimum.

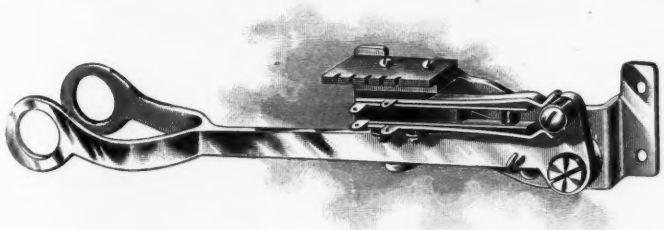


FIG. 2.—THE DOWNWARD MOVEMENT OF THE LEVER DISENGAGES THE SPRINGS AND BREAKS CONTACT.

This hook-switch is being placed on the market by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill.

The German electrical company, Siemans-Halske, it is reported, has secured the use of the Pupin patents for telephone circuits, and will make exhaustive tests.

Accurately Balanced Transformers.

During the rapid advancement of telephony in the past few years, many devices have been introduced to facilitate the transmission of speech under peculiar conditions and adverse circumstances. Among these the single transformer has played an important part, solving, as it did, the problem of connecting together a grounded and a metallic line and at the same time securing perfect service. The instrument, while simple in principle (consisting merely of an induction coil encased in an iron sheath), is wound with great accuracy in order to be effective and thus prevent a noisy line resulting from the unbalanced sections being connected together.

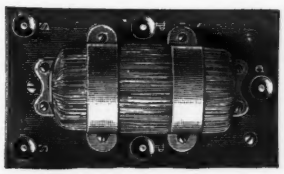


FIG. 1.—SINGLE TRANSFORMER.

The duplex transformer is also being used to a considerable extent, especially in the practice of simultaneous telephony and telegraphy over the same wires. It can also be used to convert two metallic lines of equal resistance into three metallic circuits, the price of the two necessary transformers being very inconsiderable in comparison with the cost of the labor and material necessary for an extra metallic line.

Fig. 1 shows the single transformer and Fig. 2 the double or duplex transformer. Both are similar in appearance, but differ somewhat in the resistance of the coils and the arrangement of the circuits.

The Ericsson Telephone Company, 296 Broadway, New York city, can supply these coils in any quantity, and will be pleased to furnish information as to the economical uses to which they can be put.

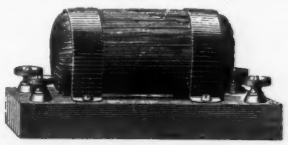
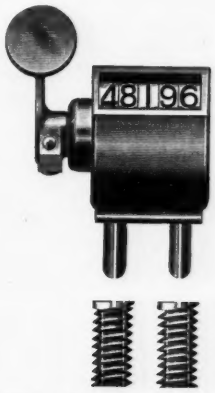


FIG. 2.—DUPLEX TRANSFORMER.

Both types are imported direct from the factory of L. M. Ericsson & Company, Stockholm, and are guaranteed to possess their characteristic perfection in mechanical and electrical construction.

Telephone Call-Counting Machines.

The Veeder Manufacturing Company, of Hartford, Ct., is manufacturing a neat device for use with either automatic or manually operated telephone apparatus. This is in the form of a small barrel counter and is so arranged that the operator can manipulate the counting mechanism by hand, or it can be attached to the lever of a pay-station or the selector hook of an automatic exchange.



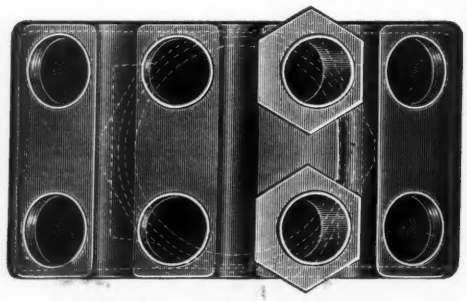
TELEPHONE CALL-COUNTING MACHINE.

These counters are made of very light construction, but at the same time are possessed of great durability, and they are finding a great deal of service in this class of work.

The terminal points in the submarine section of the London-Brussels telephone cable are at St. Margaret's Bay, Dover, and La Panne, on the Belgian coast. This will be the longest cable of its kind that has yet been laid, being ninety kilometres in length.

Novelty Terminal Head.

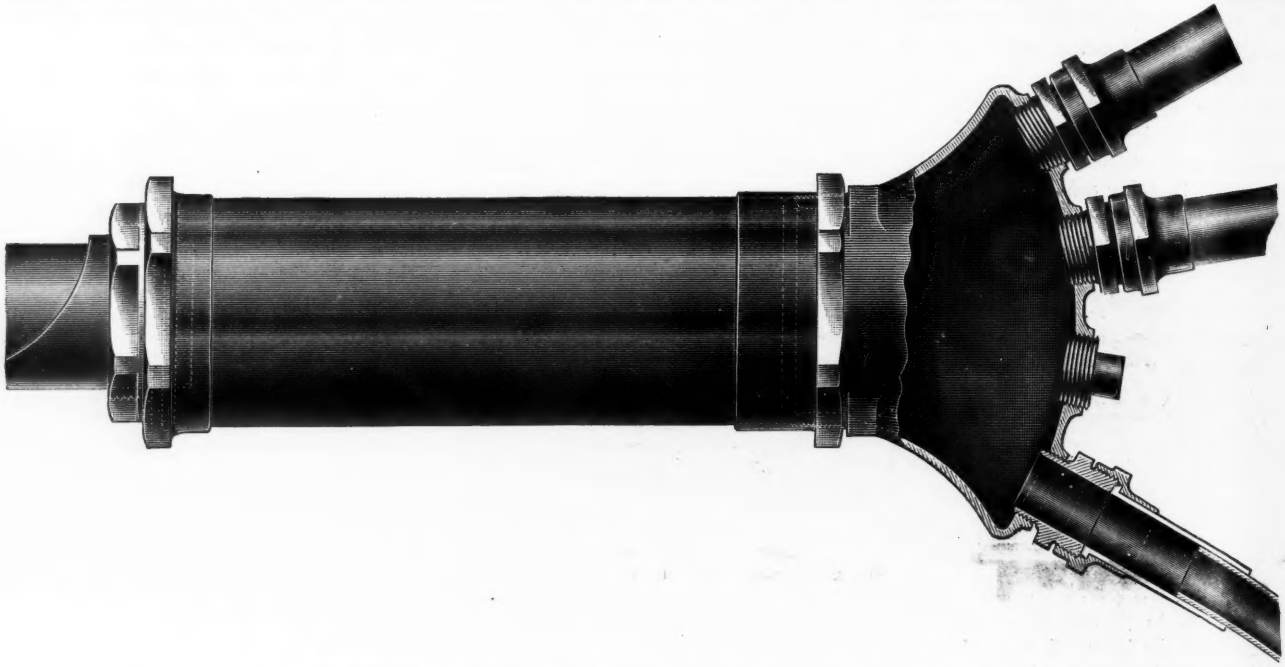
Along with many other improvements which have been made in the methods of telephone construction, the question of properly making joints of cables, and then protecting them, is one which is receiving a great deal of attention. In the greater part of the work being done at present, however, the plumber is still called upon to wipe the joint, and there are many positions in which this is a mighty inconvenient piece of work.



End View of Terminal Head.

One of the novelties which has been placed upon the market to make convenient this part of cable work is the Novelty terminal head. This, as will be seen from the accompanying illustration, is a very simple device, and does entirely away with the necessity of wiping lead branches to lead pipes. The illustration shows the Novelty terminal or branch head with eight branches. This can be made, however, for any number desired. In the terminal head illustrated, the diameter of the brass sleeve is four inches, size of head eight by four and one-half inches, and the length of sleeve twelve inches. In using this device, the holes in the terminal heads are plugged and nipples are screwed into the head as needed. Each nipple is furnished with a lead spud, and each of these can be opened or closed to suit the size of cable before soldering. The taper threaded end is unscrewed from the head, the sleeve slipped along the cable and the end already tinned is soldered by applying heat to the outside of the sleeve flange. The sleeve is screwed into the head, using a composition composed of paraffin or some other substance which, upon heating, will flow readily and make a moisture-proof joint. The cables are then placed in the nipples and the sleeves slipped back and a splice made as desired.

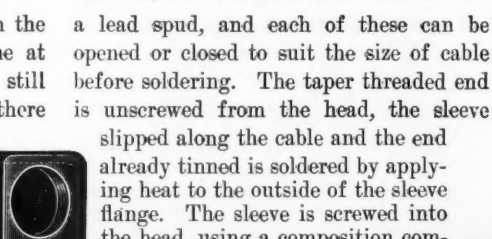
These terminal heads are made by the New Haven Novelty Machine Company, New Haven, Ct.



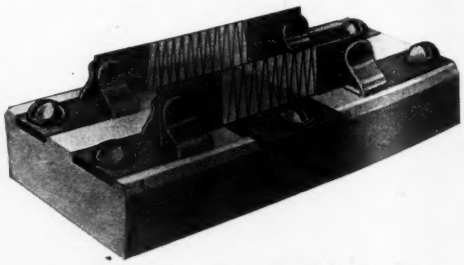
Terminal Head with Multiple Branches, for Covering Cable Splices and Doing Away with Wiped Joints.

The "Gilgen" Patent Fuse Block.

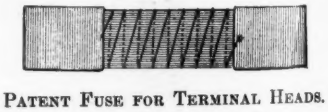
The fuse blocks shown herewith are a comparatively new development. The manufacturer claims that these are well made and highly efficient protectors. This patent fuse, as shown in the accompanying illustration, is so constructed as to give six inches of fuse and eight saw-tooth points within one-thirty-second inch of the ground plate, giving all the advantages possessed by carbon arresters. The fuse is also made of special metal, retaining the same ampere capacity and acting as a highly efficient sneak current or lightning protector. For the purpose of showing the construction, the manufacturer—the Central Telephone and Electric Company, St. Louis, Mo.—will send free a specimen to all who make a request for it.



Patent Fuse Block for Single Line.



Patent Fuse Block for Double Line.



Patent Fuse for Terminal Heads.

The National Electric Light Association.

The new rate of dues for membership in the National Electric Light Association goes into effect on January 1, 1903. This requires an entrance fee of $25 from all new members, in addition to dues. There has been a very great increase to the ranks of this association since the Cincinnati convention, 159 new active members being enrolled.

New Telephone Apparatus.

For some time there has been a growing demand for telephones for railroad work, and as a result manufacturers are giving considerable thought to the matter. A telephone is shown in Fig. 1,

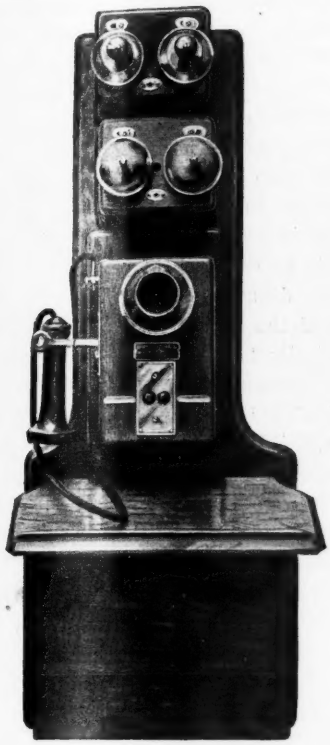


FIG. 1.—TELEPHONE EQUIPPED WITH DOUBLE SET OF BELLS FOR SIGNAL SERVICE.

which is designed for block signal service and which possesses several points of merit.

The circuits of this telephone are especially designed to meet the present wiring of railroad signal block towers and require no additional lines, the wires and ground being the full equipment. In this system a wire extends from the instrument in each direction, one up and one down the track, while a ground connection is made at the bottom of the telephone. The instrument consists of a transmitter and receiver circuit of the regular form with the exception that it is normally short-circuited instead of opened by the receiver hook. Two bridging ringers are provided of distinctly different tones, one for calls from up the track, and the other for down the track. These bells are bridged from their respective side of the line to the ground, and are always in circuit, so that if the operator was talking to the down station the up station could call, although the latter could not overhear the conversation.

A desirable feature of this telephone is that two cells of dry battery are amply sufficient to operate it, thus doing away with the maintenance of a large primary battery outfit. All the ringing is done by the magneto, by first depressing the button of the station wanted and then turning the crank which calls the desired station.

In receiving calls you merely depress the button of the station that has called you, as designated, by which gong rings, the buttons being automatically restored by the receiver hook.

FIG. 2.—POCKET TELEPHONE INSTRUMENT.

In Fig. 2 is shown a pocket telephone designed for common battery circuits. This telephone makes quite an improvement in the portable set variety, and, as can be seen in the illustration, a very neat and compact appearance.

The transmitter and receiver are arranged in series, and made of a resistance to coincide with the regular telephones in use on any system. When used as a testing set, the flexible wires are provided with the terminals in the form of spring clips, so that they may be readily connected to the locknut strip of a terminal-head, or to any point of the line as desired, the mere attaching of the clips giving the necessary call to the exchange in the same manner as when the receiver hook is raised on a regular telephone.

In addition to its use for inspectors and linemen this little telephone could be used to great advantage for police and fire-alarm circuits, in which case a flexible cord could be provided with a plug instead of clips, the equipment at the signal boxes simply consisting of a jack connected to the two sides of the line. One of the commendable features of this instrument is the absence of metal tips on the receiver cord, as can be seen in the illustration, as this practically obviates the danger of open circuits.

A very neat form of interior telephone is also being made, which is designed for the best class of hotel work. The entire mechanism is contained in a metal box, which is set in flush with the wall, having only the nickel-plated front plate visible, thereby giving it a very handsome appearance, while at the same time guarding against injury by persons knocking against it and loosening it from the wall, as often occurs in this class of work. This telephone can be wired for central energy or private line work as desired.

Another novelty manufactured is shown in Fig. 3, and consists of a telephone especially designed to go on existing push-button call circuits. It consists of a push-button which is to all outward appearances the same as the regular style, but which carries in addition to the regular push contact a plug connection on its upper side. The telephone set, as can be seen in the illustration, consists of a special plug of hard rubber carrying two contacts, to engage the two wires of the call-bell circuit, and is also provided with a hook on which to carry the special type hand telephone when not in use. The telephone proper consists of a transmitter and receiver mounted together and connected in series, the contact being closed by the spring in the handle when held in the hand.

FIG. 3.—TELEPHONE APPARATUS FOR PUSH-BUTTON CALL EQUIPMENTS.

This apparatus is manufactured by the De Veau Telephone Manufacturing Company, New York city.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A Storage Battery without Jars.

For several years, while Malcom O. Smith was an employé in the mechanical and electrical departments of one of the largest storage battery companies in the country, he sought to devise a new and improved battery. Like all other inventors along this line, he sought for four things—more power from a more compact and lighter battery that could be made at a reduced cost.

As a result of his years of study and observation of the features of different styles of batteries, he invented the Smith storage battery, now being placed on the market by the Smith Storage Battery Company, of Binghamton, N. Y.

A decrease in weight, to accomplish a given amount of work, of forty per cent, a gain of one-third in compactness, a reduction in cost of one-third and a substantial gain in efficiency in every way, are the claims for this battery which the maker is now prepared to demonstrate.

In inventing this battery, Mr. Smith did not seek for new principles to make a battery from some hitherto unused substance in a new way. He simply tried to take advantage of the old principles of making a battery with lead plates acted upon by dilute sulphuric acid; but to so apply those principles that he could secure the greatest amount of work attainable from a given amount of lead and acid. In doing that, he made a radical departure from the beaten path of storage battery manufacture in the style and form of his battery.

Patent experts say that this is the first storage battery in many years for which patents have been granted on every claim presented without modification. This shows how important are the features of this battery. Mr. Smith first tried to devise improvements in the style and method of processing in which he has been successful. With his past fourteen years' experience with other companies he has a thorough knowledge of all storage batteries now on the market, and he had to have something better than anything made before. He at first tried this style of processing on the plates of an ordinary jar battery, and found that he had gained about ten per cent in work attainable from a given weight. He then dispensed with the use of jars altogether by designing his tray batteries, in which the lead plates themselves are used for holding the electrolyte. The gridded plates are formed into oblong trays, pointed toward the bottom so as to permit of nesting.

In making up one of these batteries any desired number of trays can be nested on top of each other, separators of perforated sheets of hard rubber or other suitable acid-proof material keeping the trays from contact with each other. As nested, there is sufficient space between the trays to hold the electrolyte, which is as much in contact with the bottom of the tray above it as with the inside of the one which holds it. This permits of an equal chemical action upon the upper side of one plate and the under side of the one above it.

TRAY PLATE STORAGE BATTERY.

In preparing the plates, the under side of each tray is chemically treated to become oxide, and the upper side peroxide of lead. This makes the upper side of each tray the positive side, and the under one the negative side of what in other batteries would be a single cell.

By adding another tray to the nest the potential is increased by two volts, the same as adding another cell to an ordinary battery. The under side of the bottom tray and the upper side of the upper one are plain, and are inactive. The voltage of any battery will accordingly be twice as much as the number of trays, minus one. A battery of eleven trays will accordingly give twenty volts, being the same as an ordinary battery with ten cells. In fact, the discharge potential is 2.1 volts per cell for a good share of the time on a normal discharge.

For regular work there is no connection between the plates of the battery except the electrolyte, the use of "jumpers" between the plates being unnecessary. The negative terminal is connected to the top of the upper tray, positive terminal to the top of the bottom tray.

It is possible, however, to obtain any combination of series-multiple or multiple-series connections that can be obtained in any battery by attaching terminals to as many of the trays as the service demands. The voltage of that part of the battery used will always be practically twice as much as the difference between the numbers of the cells used. Thus current taken from the top of the third and the bottom of the seventh trays will be eight volts, and the potential between the upper side of the fifth and the under side of the twelfth will be fourteen volts.

One of the features of this type of battery is claimed in its extremely low internal resistance. The discharge is at all times from the entire surface of all of the plates, and at the latter part of a discharge the current does not have to come up from the bottom part of soldered joints or loose connections.

This results in the rapid or uneven manner in which it can be charged or discharged without fear of buckling. Inasmuch as the discharge is from the entire surface of all of the plates, it makes little difference as to the length of time which it is accomplished, or how changeable may be the demands for current. There is just so much energy which can readily be given up, fast or slowly, in a steady pull or by sudden jerks, just as the demand may be made upon it.

The discharge at all times from the entire surface results in a remarkably even potential, no matter how variable may be the load. The voltage is also maintained at the regular pressure until the battery is much more nearly exhausted than with other types.

These features are greatly desired for any kind of work where batteries may be employed, but it is particularly so for automobile use, where the demands for power vary so suddenly. The freedom from buckling and ready response to variable loads without change of potential are also valuable features for the use of batteries in electric railway power-houses to help smooth out "the peak of

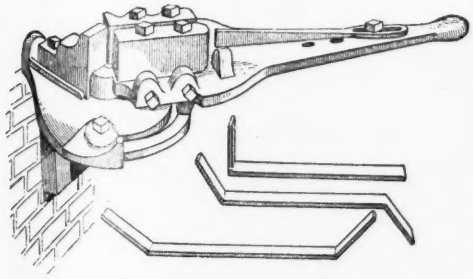
the load," as they are for automobile use.

This battery is also adapted for use in isolated electric lighting plants, for residences, hotels, factories, etc., its steadiness of discharge and evenness of potential recommending it for that work.

From what the maker of this battery has been able to demonstrate, it would seem as if it has done much to solve the problems at which the storage battery people have long been working, and the reduction in weight, cost and space made possible by this invention will do much toward increasing the use of storage batteries in all fields into which it has already entered, and bring it into use in many other departments of work.

Angle-Bending Tools.

These implements are found of great service in machine shops, foundries, automobile factories, engine factories, and in all classes of service where it is necessary to bend rods or bars in small angles. These may be utilized for bending right angles, obtuse angles or acute angles of any degree. The apparatus shown in the accompanying engravings is for hand work entirely, and is designed especially with the object of making clean, square angles. Many light jobs can be bent cold, while for its size, the instrument takes up in hot bending some of the heaviest pieces



ANGLE-BENDING TOOLS.

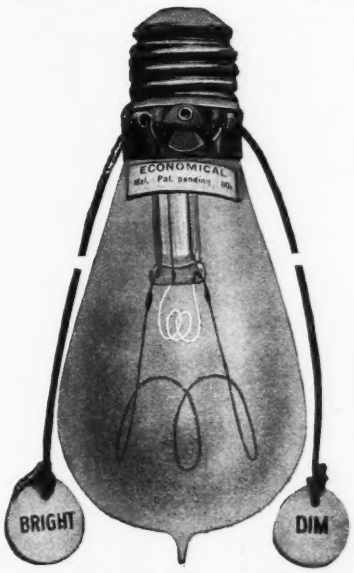
of work. The angle-bender is always ready for use, and can be adjusted for any angle or stock within a few moments' time. Both angle and eye-benders are secured removably to brackets which may be fastened to the forge frame or placed in any other location in the shop convenient to the operator.

For the bending of supplies pertaining strictly to electrical apparatus, these benders find practical service in making cross-arm cleats and angle braces. They are also being utilized very extensively for clamp and strap bending for transformer hooks.

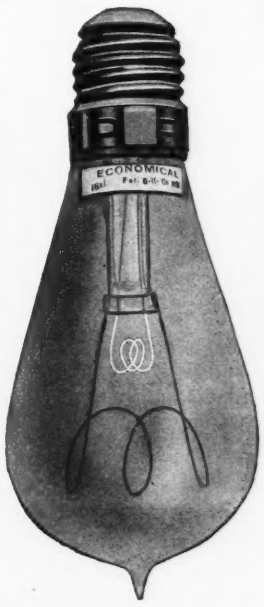
These tools are manufactured by the Wallace Supply Company, Chicago, Ill.

A Demand for Turn-Down Lamps.

The Economical Electric Lamp Company, 123 Liberty street, New York city, has recently placed an order of 175,000 turn-down lamps with the Bryan-Marsh Company for its consumption. The company is shipping a large quantity of these turn-down lamps throughout the country, and is recently in receipt of an order for



TURN-DOWN LAMP, MANIPULATED BY PULLING CORD.



TURN-DOWN LAMP, MANIPULATED BY TURNING BULB.

25,000 from one concern alone. It is also sending several large shipments to California, and is equipping a number of isolated plants. One of the great advantages the company claims for the Economical lamp is its simplicity. Without any other attachment, it can be put on the most complicated of shades and operated by cords attached to the lamp, or by simply turning the bulb as may be desired. The lamps are made in any voltage or base to suit the installation for which they are intended.

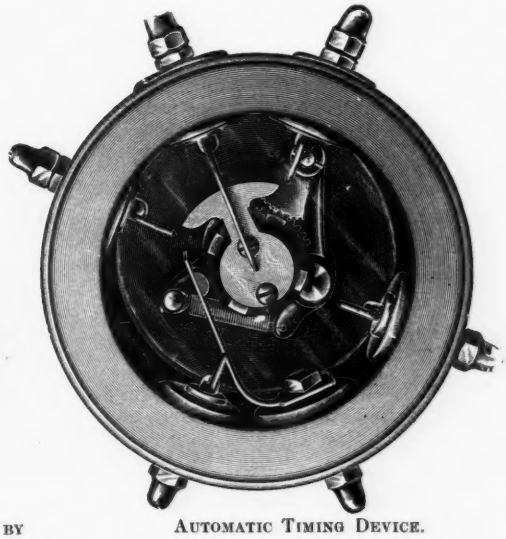
The illustrations herewith show the types of these lamps.

A Correction.

Through an unfortunate error in the ELECTRICAL REVIEW of last week, the National Cable and Wire Company, which has recently established an elaborate wire-drawing and cable-making plant in Shousetown, Pa., in the vicinity of Pittsburg, was designated as the "American Cable and Wire Company." The officers of the National Cable and Wire Company are: David Carlin, president; Joseph A. West, vice-president; J. E. Powell, treasurer; H. W. Klein, secretary, and M. W. Wachter, superintendent.

An Automatic Timing Device.

The novel and compact timing device shown in the accompanying illustration for gas engines is called "The King Automatic Timing Device." This apparatus automatically times the point of ignition, thus always giving the maximum power in the engine. A throttle valve on the engine, controlled by the operator, indirectly acts upon this governor, as the speed is varied. The attention of the operator in controlling an extra lever is not needed, and bad combinations possible with the hand-controlled lead and throttle are thus avoided. The visible spark feature is excellent, as at a glance the driver can see if each cylinder is working properly, or if one is causing trouble it can be instantly detected and corrected. This timing device being ornamental in design is arranged to be placed on the



AUTOMATIC TIMING DEVICE.

dash; it can, however, be connected to any part of the engine. The case being covered with glass, it is dust-proof, and requires practically no attention. The complete weight is about four pounds.

This device is the invention of Charles B. King, and is fully protected by patents. It is manufactured and sold by the Dayton Electrical Manufacturing Company, of Dayton, Ohio, manufacturer of the "Apple" igniter.

Take-Up Device for Use in Connection with Detent on Indicator.

The great trouble experienced when using the detent on the steam engine indicator is that of the slack given up by the cord between the paper drum and reducing bushing on wheel. This slack, if not properly guided when throwing on detent, is liable to get foul, thereby in many instances wrecking the instrument or at least breaking the cord, causing delay and inconvenience to the operator.

The take-up device is presented for the purpose of doing away with all this annoyance. It is simple in construction and can be applied to any standard indicator.

TAKE-UP DEVICE FOR USE WITH DETENT ON INDICATOR

It consists of a short horizontal arm, at one end of which there is a vertical bearing in which sets a steel pillar, on the upper end of which there is a frame holding a double set of loose steel rollers. Between these the cord from the paper drum passes. On the lower end of vertical pillar there is a light spiral spring enclosed. This spring causes upper frame to revolve when cord becomes slack, and is so arranged that cord winds on frame, to be given up again when tension is applied.

The object of the device is to permit the operator to take as many cards as desired without unhooking from the crosshead or stopping the engine, no matter what speed. This, of course, pertains to indicators that are fitted with a detent and using a direct-connected reducing motion, the latter being by long odds the most popular in modern engineering practice.

Where an indicator is used in connection with pendulum, lazy tongs or reducing motion attached to engine frame, there is not so much trouble, and generally a rubber band is employed to take care of slack cord which works fairly well. In this case the take-up device is arranged in the shape of a regular guide pulley to connect direct to indicator, the guide pulley is removed and this put in its place, wound up, and it is ready for use (this can also be used with satisfaction as a guide pulley if not needed to take up slack cord, as the little pulleys are arranged to let the cord run through with perfect freedom), and immediately the detent is engaged, it picks up instantly what slack cord takes place. The tension of the spring in this device being so much weaker than the drum spring, as soon as detent is disengaged the cord is instantly released and drawn out taut and assumes its regular position.

The take-up device is not confined to these uses only. It is also attached to engine frames and used in various other ways. It is strong, well made, compact, and makes a very attractive attachment. It is good for any number of revolutions and is designed to fit all standard indicators and reducing wheels, or it can be made as a special fixture. This device is manufactured by James L. Robertson & Sons, New York city.

The Edison Storage Battery.

The Edison Storage Battery Company, of Orange, N. J., after many severe and long-continued tests, is now prepared to manufacture the new Edison storage battery. Special tools and dies are being completed, and early in January the battery will be placed on the market.

Several of the large dry-goods houses of New York city have arranged for the equipment of delivery wagons with this battery, and a number of manufacturers of electric automobiles have given orders for the battery. Mr. Edison, who is the president of the company, and other officials are greatly pleased with the result of all the experiments and trials to which the battery has been subjected in a variety of uses, and are assured of its commercial success.

Electrical Cooking Range and Broiler.

Maurice Bayno, caterer for the Shippers and Travelers' Exchange, New York city, has invented an improved cooking range and broiler upon which patents have recently been issued. With this apparatus, utensils may be heated on the top of the stove, above a set of heating coils, while baking or roasting is taking place within a properly proportioned oven. A special compartment, designated as the "broiler box," can be utilized at the same time for broiling. The switches connected with the several coils are so arranged that one or more sets may be used independently. The broiler box can be used independently of the range, and can also be removed from its shelf and placed upon a suitable support for individual use.

Street Railway Progress in New York.

By its present system of distributing power from the Ninety-sixth street and East River station, the Metropolitan Street Railway has been enabled to close down a number of the older stations. These have been replaced by substations in which transformers and synchronous converters transform the high-potential alternating currents of 6,600 volts to direct currents suitable for operating the cars. One of these stations which has been closed down recently is that at Twenty-fifth street and Lexington avenue. This equipment was installed about four years ago, and was at that time the latest practice. Four direct-coupled units, consisting of Allis engines and General Electric generators, each having an output of 850 kilowatts, were installed.

The rapid progress in large railway operation in the last few years has rendered these units unsuitable for roads of this size, and they have, therefore, been disposed of in entirety to Rossiter, McGovern & Company, of New York, who have sold them to railways in Massachusetts.

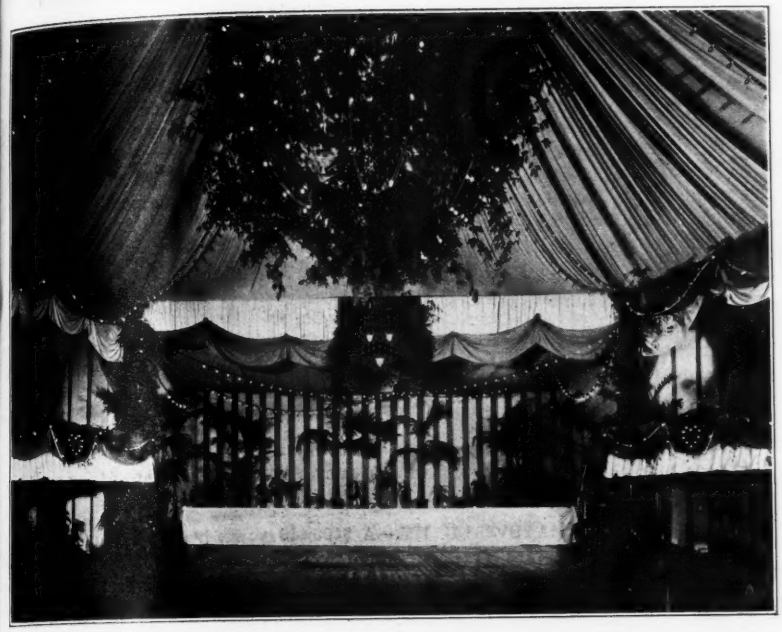
It is probable that in no other industry has such rapid advance been made as in electric traction, as this instance illustrates. In four years it has been necessary to replace these fine large units, due to a radical change in the method of generating and distributing power.

One of the other generating stations—that at 146th street—was also closed down recently, and its fine equipment disposed of by Rossiter, McGovern & Company.

A tank five feet six inches square would hold 226.28 U. S. gallons for every foot in depth. A round tank five feet six inches in diameter would hold 177.72 U. S. gallons for every foot of depth.

Ball-Room Decorations.

The use of small incandescent lamps for decorative work has been given a great impetus through the manufacture and use of the Elblight system of lighting, designed by the National Improvement Company. This company has recently been purchased by the Elblight Company of America, under the direction of Mr. Russell Spaulding. The accompanying illustration shows some of the decorative effects produced at the recent ball given in Lyceum Hall, Morristown, N. J., by Mr. and Mrs. Richard McCurdy. The floral decorations were very lavish and the electric illumination was artistically arranged, the great flexibility of the Elblight cable being used with great effectiveness. This system of lighting consists of twin conductors, carrying current, contact with the lamps being made by copper terminals being plugged into the thick insulating covering of the conductors. This system has been very widely used during a great many recent functions at Newport, notably the decorations of the Casino during the season just past. Some of the most notable decorations, in addition to the Lyceum Hall, at Morristown, and the Casino, at Newport, were the decorations at the Grand Army convention at Washington and the Casino Theatre decorations on the occasion of the New York state bankers' gala performance. In supplying the decorations for this occasion, the feat of the Metropolitan Opera House, New York city, was reproduced under much greater difficulties. Everybody can remember the gorgeous display that was made on this occasion; but the decoration of the curtain was simplified by the fact that it was lowered and raised in a straight line. The construction of the Casino Theatre compelled the Elblight company to double the curtain up and store it away in a twelve-inch space during the performance. It is stated that the operation was completed very successfully, the lamps burning all of the time.



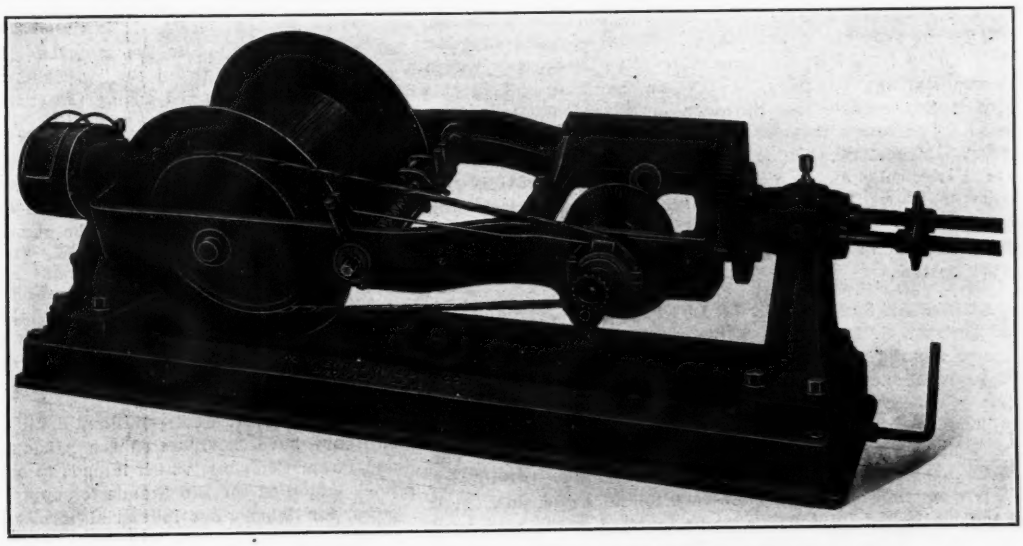
ELECTRIC LAMP DECORATIONS IN BALL ROOM.

A New Stranding Machine.

Among the many additions to apparatus for service in connection with the wire industry, the universal stranding machine shown in the accompanying engraving is one which is of practical value and is finding an extensive service in many important manufactories. This machine is designed for stranding any number of small wires into bunched cables. The wire passes directly from the spools through a die-plate, the holes of which are uniformly spaced, to and around the feed wheel, which is eight inches in diameter, then to the revolving reel, which is twenty inches by thirteen inches. The wire is guided uniformly on this reel by a transverse motion which is adjustable from three thirty-seconds to three-sixteenths of an inch.

Change gears are furnished for a variation of lay from three-quarters of an inch to three inches. The machine occupies a floor space of seventy-three and one-half inches by twenty-one and one-quarter inches, and weighs 725 pounds. The speed is 250 revolutions per minute.

This machine is manufactured by the New England Butt Company, of Providence, R. I. The company has many sizes and combinations of regular braiding machines, as well as these new special machines, and makes a specialty of building machines to specifications and plans for all kinds of service in this class of work.



MACHINE FOR STRANDING SMALL WIRE INTO BUNCHED CABLE.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

LARGE POWER PLANT ON THE POTOMAC—Work will soon be begun toward the erection of a $3,000,000 power plant at the falls of the Potomac River. This plant is to supply the city of Washington with light, heat and power for car lines and other industries.

GERMAN ELECTRIC MERGER—It is stated that a combination of several electric concerns has been effected in Berlin for the purpose of underbidding American competition. The members of the combination are said to be the Allgemeine Elektricitäts Gesell schaft and Siemens & Halske, of Berlin, and the Schuckert Company, of Nuremburg.

THE EVERETT-MOORE SYNDICATE OBLIGATIONS ENTIRELY CANCELED—The sale of the Toledo-Detroit Shore Line Electric Railroad to the Grand Trunk and Clover Leaf Railroads, for $1,500,000, has been ratified in Cleveland, Ohio. A large share of the purchase price is to be paid in bonds. This deal will enable the Everett-Moore Syndicate to cancel all its obligations due to the purchase and improvement of the road, and practically solves the entire traction situation, which some months ago involved between $60,000,000 and $65,000,000.

AUSTRALIA TO HAVE AMERICAN TROLLEYS—More than $7,000,000 worth of American equipment, etc., will be used in the construction of trolleys in the city of Adelaide, South Australia. This is the largest amount of American material which has been ordered for a foreign electric system. The contract has just been awarded to an Australian electrical engineering and contracting firm of Sydney and Adelaide, acting on behalf of the American company. The Dunedin (New Zealand) electric traction system is also to have American equipment.

THROUGH TROLLEY LINE FOR EIGHTY MILES—A project is under way for a through line from Waterbury, Ct., through the Naugatuck Valley to Derby, Ct., thence through Derby and the Norwalks to Stamford, a distance of eighty miles. The entire system will be the property of the Connecticut Railway and Lighting Company, and will parallel the lines of the New York, New Haven & Hartford Railway Company. Plans for the final link in this chain of trolley roads—from Seymour to Naugatuck—have been completed. The towns through which the system will pass are: Waterbury, Naugatuck, Union City, Beacon Falls, Seymour, Ansonia, Derby, Shelton, Oronoque, Putney, Stratford, Bridgeport, Fairfield, Southport, Westport, Saugatuck, Norwalk, South Norwalk and Stamford. Over the lines already in use a freight and express system is in operation. This will be extended to cover the entire system.

AN AMERICAN SYNDICATE TO LIGHT PARIS—The fact that Messrs. Anthony N. Brady and William C. Whitney, both of New York, have secured the sole right and contract to illuminate the city of Paris, France, has become known, and it is predicted that a scheme of considerable magnitude is under way to carry out this project. French financiers have known for some time that the Brady-Whitney syndicate agents were making propositions to obtain control of the municipal lighting business. On Wednesday, December 3, the Paris councilmen voted the contract to the Americans. It is stated that unlimited millions are to be invested in the enterprise. The title of the company has not yet been made known. The new corporation will absorb all the gas companies of Paris, and later on the electric light companies will be taken in. Improved American methods in the manufacture of gas and electricity will greatly lessen the cost of production, it is expected.

PLAN FOR LARGE POWER PLANT—A dam is now in course of construction twenty miles above Niles, Mich., at a point which is known as the Twin Branches. At this point two small streams empty into the St. Joseph River. An expenditure of at least $1,000,000—possibly $2,000,000—is being made in the construction of this dam, which is to harness the waters of the St. Joe. It is expected that a total of 12,400 horse-power will be developed upon the completion of this dam. This power will be transmitted to all the important cities of the valley within a radius of twenty miles. The enterprise has been undertaken by the St. Joseph & Elkhart Power Company, an Indiana corporation, whose plans also provide for another dam at Berrien Springs, Mich., to develop 2,500 horse-power, and another of about the same size midway between Niles and South Bend, all three to control the water power of the St. Joseph River. Work was begun in July, 1901, and the company expects to be ready to transmit power by June next.

ELECTRIC LIGHTING.

BAY CITY, MICH.—An electric light plant is being put in at Harrisville.

ARGYLE, MINN.—The village council has accepted the new electric light plant and it is now being operated by the village. The cost was $15,000.

SYRACUSE, N. Y.—It is stated that a project is on foot to transmit power from the St. Lawrence Power Company's plant at Massena through the northern section of the state as far as Watertown.

MAYSVILLE, KY.—A $100,000 power-house will be built by the Bluegrass Traction Company to furnish power for the lines from Lexington and Georgetown and from Lexington to Paris.

NASHVILLE, TENN.—Work on the new plant of the Cumberland Electric Light and Power Company is being pushed rapidly, and it is expected that the plant will be completed and put into use about March 1.

MILLERSBURG, OHIO—The Millersburg electric light plant has been sold to O. P. and M. J. Van Sweringen, of Cleveland, who have taken possession. The new firm will improve the plant, and will, in addition, add a neating plant.

IOWA FALLS, IOWA—It is stated that a movement is on foot at Reinbeck, looking to the granting of a franchise to a private corporation to put in an electric light plant and water plant. A company will be formed among the citizens in case a franchise is granted.

ALLIANCE, OHIO—At a recent meeting of the Sebring Land Company, the Sebring electric light plant, owned and operated by the company, was sold to E. H. and Fred Sebring. The sale of the plant was consummated for the purpose of its enlargement and improvement.

SOUTH ORANGE, N. J.—The United Electric Company has made application for a franchise in the village. The franchise would be limited to twenty years, and at the end of three years the company would be compelled to pay the village a certain percentage of the gross earnings.

SANTA FE, N. MEX.—William S. Iliff, J. S. Macbeth and Joseph J. Henry have incorporated the Albuquerque Gas, Electric Light and Power Company, which intends to erect power works in White Rock Canon on the Rio Grande to supply Albuquerque with electric power for lighting and industrial purposes. The capital is $200,000.

ABERDEEN, MD.—The town council of this village has made a contract with a newly formed electric company to light the streets of the town for the next five years. The officers of the new company are: D. B. Arthur, president; J. A. Swingley, treasurer; Dorsey Rowe, secretary, and L. A. Funk, of Boonsboro, general manager.

CHELAN, WASH.—At a recent meeting of the city council, ordinances were passed granting franchises to the Chelan Water Power Company for an electric light and power plant. According to the terms of the franchise, work must begin within two months from the date of the passage of the ordinance, the franchise to cover a period of fifty years.

ELECTRICAL SECURITIES.

Following the sensational manipulation of local securities for the past two weeks, the period just passed over is somewhat dull and uneventful. There has been little in the past week to improve financial developments. Speculation has been limited to professionals and there has been as a rule a tendency of prices to sag and seek declines. Considerable uneasiness is felt regarding the money outlook, and especially for the balance of the month and the early part of the new year. Prophecies are being made that call rates will reach a high record mark, and should this not be the case the financial district will be agreeably surprised. However, the precedent which has recently been established by the present officers of the Treasury and those involved in the conduct of national finances give a reasonable assurance that in the event of serious stringency proper measures can be expected at very short notice. The President's message has been received as generally purporting no serious tinkering with industrial consolidations, and it is hardly probable that there will be any radical revision in tariff measures. On the whole, the document is regarded as a bull measure.

The general prosperity continues unabated and trade conditions show a stability which is unquestioned. The most recent reports have been particularly good, and there is such a volume of freight being moved that holders of railway securities can have no cause for complaint for some time to come. This phase is one which reflects a distinctly good condition and shows a continued activity in almost every branch of national production.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 6.

New York:	*Closing.*
Brooklyn Rapid Transit	64½
Consolidated Gas	211
General Electric	176½
Kings County Electric	210
Manhattan Elevated	147¾
Metropolitan Street Railway	139¼
New York & New Jersey Telephone	161
Westinghouse Manufacturing Company	206

The regular quarterly dividend of 1¾ per cent and a bonus of 1 per cent will be paid on January 2 to stockholders of record on December 20, 1902, by the Commercial Cable Company.

The directors of the General Electric Company have declared the regular quarterly dividend of $2 per share upon the common stock, payable January 15, this for stock of record December 20.

The directors of the Manhattan Elevated Railway Company have declared a quarterly dividend of 1½ per cent, payable January 2. Notice has been given that a special meeting of the stockholders of the company will be held at 195 Broadway, New York city, on January 16, 1903, at twelve o'clock noon. At this meeting a proposition will be submitted to the stockholders for their sanction, approving of an increase in the capital stock of the company from $48,000,000 to $60,000,000.

At the annual meeting of the stockholders of the Metropolitan Street Railway Company, which was held last week, the following directors were elected: H. H. Vreeland, P. A. B. Widener, Thomas Dolan, D. B. Hasbrouck, H. A. Robinson, William Fahnestock, DeC. Moorehead and R. W. Meade.

Boston:	*Closing.*
American Telephone and Telegraph	160
Edison Electric Illuminating	267½
Massachusetts Electric preferred	94
New England Telephone	137
Western Telephone & Telegraph preferred	98

The Boston and Northern Old Colony systems, subcompanies of the Massachusetts Electric Company, report gross earnings of $5,768,079. This is for the year ended September 30, 1902. The gross earnings of three small roads and electric lighting properties will bring the total up to about $6,000,000, an increase of about $250,000 over the earnings for the previous year. The Massachusetts Electric Company has declared a semi-annual dividend of 2 per cent on its preferred stock, payable January 2.

Philadelphia:	*Closing.*
Electric Company of America	9½
Electric Storage Battery common	80
Electric Storage Battery preferred	80
Philadelphia Electric	8½
Union Traction	47
United Gas Improvement	110½

United Gas Improvement and Philadelphia Electric displayed absolutely no activity during the week.

The Union Traction Company has declared a semi-annual dividend of 2 per cent, payable January 2.

Chicago:	*Closing.*
Chicago Edison Light	175
Chicago Telephone	156
Metropolitan Elevated preferred	85
National Carbon common	26
National Carbon preferred	97
Union Traction common	13¾
Union Traction preferred	45

Chicago Edison rose to 177 on purchases of 87 shares. The company will issue $2,277,000 additional capital stock, the increase amounting to 30 per cent of the stock now outstanding. Stockholders of record January 24, 1903, will have the right of subscribing pro rata at par to the new issue.

The Chicago Telephone Company has declared the regular quarterly dividend of 2½ per cent, payable January 2 to stock of record December 27.

The Metropolitan West Side Elevated is maintaining its former rate of increase in traffic compared with the corresponding rate last year.

NEW INCORPORATIONS.

OLEAN, N. Y.—Berney Traction Company. $50,000.

PITTSBURG, PA.—Shadyside Electric Light Company. $15,000.

MONTAGUE, MISS.—Montague Electric Light and Power Company. $2,000.

MOLINE, ILL.—Moline Power Company. Increased from $2,400,000 to $3,200,000.

LEXINGTON, KY.—Blue Grass Traction Company. Increased from $10,000 to $35,000.

MENOMINEE, MICH.—The Menominee Electrical Manufacturing Company. $60,000.

LOS ANGELES, CAL.—Los Angeles Lighting Company. Increased to $2,500,000.

BARABOO, WIS.—Baraboo Lighting Company. $100,000. Incorporators: B. H. Strong, George I. McFarland and Daniel Ruggles.

KITTERY, ME.—The Standard Power Company. $5,000,000. President, Hiram Thompson, of Kittery; treasurer, William P. Huelin, of Kittery.

LINCOLN, NEB.—The Union Telephone Company. $25,000. Incorporators: P. F. Murray, J. C. Hass, E. H. Mason, T. Coe Little and T. A. Anthony.

RIVERSIDE, CAL.—Corona Power and Water Company. $250,000. Incorporators: T. P. Drinkwater, L. R. Curtiss, E. N. Currier, W. C. Barth, M. Terpening.

TRENTON, N. J.—The Salta Light and Trading Company. $130,000. Incorporators: Emil J. Oberlaender, Gustave Oberlaender and Claus R. von Egloffstein.

SAN FRANCISCO, CAL.—Richmond Light and Power Company. $150,000. Directors: W. A. Bissell, W. P. Treat, N. T. Messer, E. Schwab and W. C. Webb.

CANAAN, N. Y.—The Frisbie Street Line Telephone Company. Directors: E. P. Jenkins, F. S. Hall, E. H. Cady, A. Lape, R. H. Girdler, A. Strump and H. H. Park.

ONEONTA, N. Y.—Otsego Light, Heat and Power Company. $100,000. Directors: Edward C. White and Herbert T. Jennings, Mount Vernon; Charles V. D. Peek, New York.

NORTH BRANCH, MINN.—Maple Leaf Telephone Company. $50,000. Incorporators: F. F. Murray, Charles Avery, J. H. Beggs, A. V. Plunkett, O. W. Fagerstrom, all of North Branch.

JERSEY CITY, N. J.—Whatcom County Railway and Light Company. $1,050,000. Incorporators: Henry B. Sawyer, Henry G. Bradlee, Preston Player, Henry R. Hayes, Alvah R. Todd, Gardiner Rodgers, John W. Oakes and John W. Hallowell, all of Boston, and Kenneth K. McLaren, of Jersey City.

ELECTRIC RAILWAYS.

GUTHRIE, OKLA.—Active construction work on the South McAlester-Haleyville electric line has commenced. It will cost $450,000.

COLUMBUS, OHIO—The Northern Ohio Traction and Light Company has been incorporated for the purpose of building an electric line from Akron to Cleveland.

CAMDEN, N. J.—The town council has granted a franchise to the Camden & Suburban Railway Company to extend its line from West Collingswood to Haddon Heights.

SHELBYVILLE, IND.—Arrangements are being completed for the extension of the Indianapolis, Shelbyville & Southeastern Traction Company's line from this city to Batesville.

SANTA CRUZ, CAL.—Fred W. Stanton and others have been granted a franchise for an electric road from Santa Cruz to Capitola, and also a franchise to operate a road in this city.

BATTLE CREEK, MICH.—A company is being organized here to build an electric line to St. Mary's Lake, five miles north of this city. The company building the line will also open resort grounds.

MILWAUKEE, WIS.—Articles of incorporation have been filed with the Secretary of State for a company to construct an electric line from Green Bay to Manitowoc, by way of Depere and Two Rivers.

HARMONSBURG, PA.—A charter has been granted to the Meadville, Conneaut Lake & Linesville Electric Railway Company for the building and operating of a trolley line between Meadville and Linesville, by way of Harmonsburg.

MARYSVILLE, OHIO—The Toledo, Columbus, Springfield & Cincinnati Electric Railway has filed application with the Marysville council for a franchise through the city. This is the line that is projected from Toledo to Columbus by way of Lima and Bellefontaine.

SCHENECTADY, N. Y.—The Oneonta, Cooperstown & Richfield Springs Railway Company has filed with the Secretary of State a certificate showing that it proposes to extend its route from Oneonta to Laurans and Mount Vision; also to Cooperstown and, beginning at Oak Creek, to the village of Mohawk.

FREEPORT, L. I.—The New York & Long Island Traction Company has started work on the extension of its line west toward Rockville Center, which line will extend to Springfield, where it will connect with the trolley running into Jamaica. The company expects to have the new route in operation by next May.

DULUTH, MINN.—The county commissioners have granted a franchise to the Missabe General Electric Company to build a line traversing the towns of Mesaba, Missabe Mountain, Fayal, Nichols, Clinton and Stuntz. It is understood that the first work of the company will be at Virginia and that a line will be run from that place to Eveleth.

DALLAS, TEX.—The Beaumont, Port Neches & Port Arthur Electric Railway Company has been organized for the purpose of building an electric road from Beaumont to Port Arthur. It is stated that the necessary money has all been secured and that the only delay will be in the securing of material of every description, especially machinery.

MANKATO, MINN.—U. P. Hord, of Aurora, Ill., and F. G. Keator, of Chicago, have asked the council for a franchise for a street railway line to run through the streets of the city. They are interested in a company which proposes to put in an interurban line from Mankato to Kasota and St. Peter, with the view of soon extending to St. Paul.

GREENSBURG, VA.—Newlinsburg and Murraysville capitalists have organized a company for the building of a street railway from Trafford City to Murraysville. A charter has been applied for, and the extension of the line to Apollo and New Kensington is a possibility. The charter members are Rush D. Hiller, W. S. McClure, John Stewart and Calvin Good.

KOKOMO, IND.—George Marott, of Indianapolis, who a few months ago purchased the Kokomo electric light and railway plants, has just completed improvements and track extensions costing $100,000 and has plans laid for the expenditure of another $100,000. The railway trackage has been more than doubled and the electric lighting system greatly improved.

LANSDALE, PA.—A new trolley line is projected from Spring House, Montgomery County, to Dublin, Bucks County, a distance of about sixteen miles. It would pass through Montgomery Square, Montgomeryville, Colman, Line Lexington and Leidytown. Philadelphia capitalists are now securing the right of way. At Spring House it would form a junction with the existing Lehigh traction line.

LOUISVILLE, KY.—At a meeting of the board of directors of the Louisville Railway Company, held recently, it was decided to build an electric line to Jeffersontown, and ultimately to extend the system to various other points in the county, making a large interurban system. The work on the line to Jeffersontown will begin at once, and the company states that it will be in operation within six months.

NEWTON, KAN.—The Union Electric Railway and Construction Company has applied for a right of way for an electric line through Harvey County, connecting McPherson, Newton, Arkansas City and intermediate points with Wichita. The road will be for both passenger and freight traffic and will, in all probability, be extended to other towns. Construction is to be begun as soon as possible.

MARQUETTE, MICH.—It is announced that the remainder of the right of way has been secured and that the work of constructing an electric road between the cities of Marquette and Negaunee will be started in the spring. The distance is fifteen miles. The line will be financed by a Toledo and Cleveland syndicate, and will connect here with the local trolley line and at Negaunee with the line running to Ishpeming.

PAOLI, IND.—At a special meeting of the town council the New Albany, Paoli & French Lick Valley Traction Company received a franchise over the streets of the town. The promoters of this line agree to begin operations by June 1, 1903, and to fully complete the line by September 1, 1904. All other towns along the proposed route, with the exception of New Albany, have granted the company similar rights.

WARSAW, IND.—L. D. Fleming, representing Lagrange and Ligonier capitalists, made application to the Warsaw city council recently for a franchise for an interurban electric line to connect Lagrange and Warsaw and the intervening towns of Ligonier, Syracuse, Wawasee, Milford and Leesburg. It is reported that the enterprise has been financed and that much of the right of way outside of the towns mentioned has been secured.

SALAMANCA, N. Y.—The Berney Traction Company has been organized with a capital of $50,000, the purpose of the company being to build and operate an electric road from Salamanca to Great Valley. The length of the proposed system is about four and one-half miles. Officers have been elected as follows: President, Andrew Edgett; vice-president, Julius Eloskey; secretary, Robert L. Edgett; treasurer, Stephen A. Holbrook, all of Bradford.

QUINCY, ILL.—Contracts have been signed for the building of an interurban electric line from Quincy to Beardstown and from Quincy to Niota. At Beardstown, the road will connect with the Baltimore & Ohio Southwestern, and at Niota with the Santa Fe system. The line to Beardstown will be running by June next. Upon the completion of these lines, it is understood that another line will be built south through Pike and Calhoun counties to St. Louis.

CINCINNATI, OHIO—The Cincinnati, Milford & Goshen Traction Company and the Cincinnati, Milford & Loveland Traction Company have been merged under the title of the Milford, Loveland & Goshen Traction Company with a capital of $850,000. The construction of the road to Milford will begin at once, and later branches will be built to both Loveland and Goshen. Still later, extensions will be built to Washington C. H., Wilmington, Blanchester, Chillicothe and other near-by towns. The contract for the line to Milford has been let, and calls for the completion of the work within nine months.

PERSONAL MENTION.

MR. D. B. DEAN, of the John G. Brill Company, Philadelphia, was a New York visitor last week.

MR. R. L. DUNN, electrical and mining engineer, of San Francisco, is visiting in the East, a guest of the Imperial Hotel.

MR. WILLIAM B. G. ALLEN has resigned from his association with the American Vitrified Conduit Company. Mr. Allen was secretary and treasurer of this company.

MR. WILLIAM J. CLARKE, London, England, manager of the foreign sales department of the General Electric Company, is renewing old friendships in the United States.

MR. IRVING B. SMITH, secretary and treasurer of the Wirt Electric Company, Philadelphia, paid a visit of several days' duration to the home office at Philadelphia. Mr. Smith is now back at his New York headquarters, 180 Broadway.

MR. ARTHUR STANLEY RIGGS, a former member of the staff of the ELECTRICAL REVIEW, is now editor of *The Daily Bulletin* at Manila, P. I. Mr. Riggs writes that the work is very interesting and that our new dominion in the Orient "is a great country."

MR. STEPHEN V. MORRIN, formerly of the Climax Boiler Company, of Brooklyn, N. Y., and more recently identified with the manufacture of this boiler in England, has returned to New York and will make this city his future home. Mr. Morrin has a wide experience in boiler manufacture.

MR. JOSEPH E. MONTAGUE, Chicago, has accepted an offer to become manager of a local lighting and power plant at Niagara Falls, N. Y. He enters upon his new duties about the middle of December. Mr. Montague has been identified for a number of years with the Chicago Edison Company, and during this time has made a wide acquaintance.

MESSRS. C. H. MACKAY, president, and George G. Ward, vice-president, of the Commercial Cable Company, and W. H. Baker and E. C. Bradley, vice-presidents of the Postal Telegraph Company, left New York city last week for San Francisco to see the beginning of the laying of the new Pacific cable to connect this country with the Hawaiian and Philippine Islands.

MR. FRANK C. MASON, superintendent of police telegraph, Brooklyn Borough, New York, is the owner of a fine old homestead near Utica, N. Y., where he was born. Mr. Mason and family intend to spend their summers on this farm, which is known as "Glen Alex," named after Mr. Mason's father. The house, stables and grounds are to be lighted by electricity.

MR. FRANCK Z. MAGUIRE, of Maguire & Baucus, London, a former New Yorker, has taken up his residence in London and spends a portion of his time each year in Berlin and St. Petersburg. His firm, which is composed of himself, Joseph D. Baucus and James F. Cummings, represents a number of American houses including the Bridgeport Brass Company.

MR. E. CUTHBERT PLATT, one of the directors of the Sprague Electric Company, and the treasurer of the Commercial Cable Company, has been bereaved through the death of his daughter, Miss Edith Hunter Platt. Miss Platt was nineteen years of age, and had been tendered a coming-out party at her residence in Brooklyn on the evening of December 6. During the night she suffered from an attack of heart failure and died before aid could be secured.

MR. H. D. CRITCHFIELD, who has been for some time general counsel for the Federal Telephone Company, of Cleveland, has resigned to accept a position with the Automatic Telephone Company, of Chicago. Mr. Critchfield has been very prominent in the independent telephone field in Ohio and the central west. He is president of the Ohio Independent Telephone Association, and is closely identified with independent interests of the national organization.

LEGAL NOTE.

SUIT BROUGHT FOR INFRINGEMENT ON TRANSMITTER AND HOOK-SWITCH—The Kellogg Switchboard and Supply Company, Chicago, Ill., has brought suit against the American Electric Telephone Company, also of Chicago, for infringement of patent No. 687,499, dated November 26, 1901, granted to William W. Dean for a telephone transmitter; and also on patent No. 704,697, dated July 15, 1902, granted to William W. Dean for a switch-hook. The company has also brought suit on the same transmitter patent against the International Telephone Manufacturing Company, of Chicago. These patents relate to the well-known Kellogg apparatus.

INDUSTRIAL ITEMS.

J. HOLT GATES & COMPANY, contracting engineers, Chicago, Ill., have removed their offices to 927 Monadnock Building, where they will continue the business of complete installations of electric and steam plants.

THE EMPIRE MANUFACTURING COMPANY, Franklinville, N. Y., has recently purchased the Citizens' Electric Light Company's plant, and intends to install a 100-horse-power engine and a 1,000-incandescent-lamp dynamo. This company will be pleased to receive pamphlets, catalogues and descriptive circulars from manufacturers of electrical apparatus.

THE DE LA VERGNE REFRIGERATING MACHINE COMPANY, New York city, is the sole licensee for the United States of the Koerting double-acting, two-cycle gas engine. This gas engine has been pronounced by experts to be meeting all the requirements of practice in proper mechanical operation. The engine is made particularly in large units, and is claimed to have a high thermal efficiency.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., makes a specialty of graphite facings for moulding work. These facings are made in a variety of forms for different classes of work. The different practices in vogue in various foundries and the condition of the work to which the facings are to be applied are carefully studied, and the graphite best suited for a particular service is carefully selected.

THE MECHANICAL BOILER CLEANER COMPANY, manufacturer of the Garrigus mechanical boiler cleaner, has just secured an order for eleven cleaners from the Milwaukee Electric Railway and Light Company. This is the fourth consecutive order from this company, and is a favorable indication of the merits of the apparatus. Mr. W. R. Mason is the sales manager for the company with offices at 413 Western Union Building, Chicago.

N. MARSHALL, assignor to the Marshall-Sanders Company, was granted a patent on November 25 for a knife switch with an aligning groove into which the contacts are drawn. This patent is the basis of the well-known Marshall-Sanders baby knife switches and covers all forms of switches having the contacts aligned by grooves in the base or equivalent construction. The Marshall-Sanders Company is now filling large and continuous orders for these switches.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., selling agent for the Guttmann alternating-current wattmeter, states that although it is shipping hundreds of these meters every week, owing to the increased facilities at the factory it is able to keep up with its orders and make prompt deliveries. The company is recommending Packard sign lamps for decorative purposes. This is the season for this type of lamp, and the company is prepared to make quick shipments.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., is illustrating in its latest bulletins the "Wood" systems of primary fuse boxes, mast arms and the B. & B. commutator truing device. This truing device is carefully described in bulletin No. 1,038, which will be sent upon request to any one who has not yet received a copy. The December panel calendar is in the characteristic Fort Wayne style and adorned with illustrations of direct-current series, direct-current, 110-volt, alternating-current, 104-volt, and power circuit arc lamps.

THE NEBRASKA ELECTRIC AND FIXTURE COMPANY, Omaha, has been formed with Messrs. A. G. Munro, E. J. Sullivan and Paul Horbach constituting the organization. Mr. Munro was formerly with the General Electric Company at Chicago, and has a wide acquaintance in the electrical field of the West, and Mr. Sullivan and Mr. Horbach are both well-known citizens of Omaha. It is their intention to establish a first-class electrical supply house in Omaha, which is the centre of a large and growing electrical territory. The standing and ability of the gentlemen forming the company assure its success.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has recently closed a contract with the Oakland Transit Consolidated located at Oakland, Cal., for the installation of a

battery of chloride accumulators to be used on its railway system. The battery consists of 264 cells, having a capacity of 550 kilowatts, and, in connection with a booster, is to be installed at the centre of distribution of the system, about two and one-half miles from the generating station. It is to be used to reduce the amount of feeders otherwise necessary and to regulate the fluctuations of load on the generators at the power-house.

THE QUEEN COMPANY, Philadelphia and New York, makes a specialty of the Queen self-regulating X-ray tube. This company has recently published a book which describes and illustrates in detail the functions and workings of an X-ray apparatus. In addition to a number of shadowgraphs made with the Queen apparatus, a number of colored plates are given, which show the X-ray tube operating properly, with the current running in the wrong direction, operating with a low vacuum, and the appearance of the light when the bulb is punctured or cracked. This book is of great value, and the company is to be congratulated upon the completeness of its description of this apparatus.

THE FRINK SYSTEM OF LIGHTING show windows and store interiors by special reflectors continues to prove its value. The manufacturer, I. P. Frink, 551 Pearl street, New York, states that some of its more recent orders were from the following: Max Weill & Company, St. Louis, Mo.; Smith, Gray & Company, Brooklyn; Hecht's stores, Baltimore; Segelbaum & Company, Braddock, Pa.; Parker, Bridget & Company, Washington, D. C.; J. Keller & Company, Kendallsville, Ind.; G. B. French Company, Portsmouth, N. H.; Goldsmith Brothers, Easton, Pa.; Woodward & Lathrop, Washington, D. C.; Gerardi Mercantile Company, Trinidad, Col.; L. Bamberger & Company, Newark, N. J., and N. Snellenburg & Company, Philadelphia, Pa.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., has recently published two attractive catalogues of seasonable articles. One of these illustrates a very complete line of electrical toys and small motors and dynamos. While these are toys, they are perfect miniature reproductions of large apparatus, and are stated to be mechanically and electrically perfect in every way. There has been an increased demand for this catalogue, and the line of material illustrated is becoming very popular. A new catalogue has also been issued on miniature incandescent lamps and fittings, showing an especially attractive line of socketless series lamps which can be used to great advantage in decorating rooms and trees for Christmas. These catalogues are mailed upon application.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., which is now the western selling agent for the house goods specialties manufactured by Edwards & Company, of New York, is carrying a stock in Chicago of all the more important items. The line of burglar alarm springs, door openers and watchmen's clocks is well known, and to these specialties have been added automobile bells, monitor bells and electric light door switches. The Western Electric Company is sending out two attractive circular letters—one announcing this agency, and the other calling attention to the new type "Sunbeam" lamp. These lamps are furnished in all efficiencies and voltages and are claimed to have long life, uniform brilliancy and even current consumption. Full information will be sent to any one interested in either of these lines upon request.

"THE TWENTIETH CENTURY LIMITED" DAILY—This is the latest addition to the Lake Shore service over the Lake Shore & Michigan Southern Railway. This train leaves Chicago at 12.30 P. M., arriving in New York at 9.30 A. M., and over the New York Central tracks leaves New York daily at 2.45 P. M., arriving in Chicago at 9.45 A. M. The use of the Twentieth Century Limited not only affords a full half day for business in Chicago, but by reason of the time of its arrival in New York gives an entire day for business in that city. The equipment is complete throughout, and comprises two drawing-room sleeping cars, one eight-stateroom sleeping and observation car, and a combined buffet, smoker and baggage car, Chicago to New York; sleeping car, Cincinnati, *via* Big Four route to New York, and a dining car from Chicago to Ashtabula and Albany to New York, serving luncheon, dinner and breakfast. The train is lighted and ventilated by electric lights and fans. In addition to the lights for illumination, each section has a reading lamp, and there are side lamps in the buffet and observation cars, and over each table in the dining cars.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has included among its shipments of engine-type generators for the month of November, one 400-kilowatt for the Stevens Girard Building, Philadelphia, Pa.; one 100-kilowatt, one 125-kilowatt for the Missouri Pacific Railway, St. Louis, Mo.; two 150-kilowatt for the Pennsylvania Malleable Company, McKees Rocks, Pa.; one 200-kilowatt for J. L. Mitchell, Philadelphia, Pa.; two 50-kilowatt for the Liveright & Greenwald Building, Philadelphia, Pa.; two 100-kilowatt for the McClintic-Marshall Construction Company, Pottstown, Pa.; one 300-kilowatt for the Grand Crossing Tack Company, Chicago, Ill.; one 400-kilowatt for the Lake Construction Company, Erie County, Pa.; one 250-kilowatt for the Wilmington City Electric Company, Wilmington, Del.; one 225-kilowatt for the Pine Bluff & Western Railway, Pine Bluff, Ark.; two 150-kilowatt, one 200-kilowatt, one 75-kilowatt for the Woodward & Lathrop Building, Washington, D. C. The company reports that its new mill building is now being occupied, enlarging the floor space by 60,000 square feet, giving increased facilities for prompt deliveries on large orders.

THE STANDARD VITRIFIED CONDUIT COMPANY, 39 and 41 Cortlandt street, New York city, is meeting with great success throughout the country in placing orders for its multiple duct conduit with patented steel key connection. This construction of conduit has received the universal endorsement of many of the largest corporations in the electrical trade. The company states that it is now working on contracts for some of the largest propositions in hand to-day, and the advantages which it has for prompt shipment have enabled it to book many large orders for export for underground work. This company's factories are among the largest in the world devoted entirely to the manufacture of all styles of multiple and single-duct conduit. The Bell Telephone Company and many of the large independent telephone interests have placed orders with the company. The company is about to issue a very complete illustrated catalogue, and states that after January 1 it will be in a position to supply sufficient conduit to meet the entire demands of the United States. In addition to the booking of orders for conduit work exclusively, the company is working on several large propositions in connection with railway construction, supplying its "Manhattan" third-rail insulator.

THE STANDARD UNDERGROUND CABLE COMPANY has about completed the erection of one of the largest and most modern plants in this country for rolling copper rods, drawing all sizes and shapes of bare wire, and insulating weather-proof wires and cables. This plant is an addition to the large underground cable factory and rubber insulated wire and cable factory at Perth Amboy, N. J. The rod mill was started successfully on November 25 and the wire mill was in full operation on December 1. The company is now prepared to furnish bare rods and wire in any quantity, the capacity of the rod mill being 3,000,000 pounds per month and the wire mill 2,000,000 pounds, single turn. The weather-proof factory will be in full operation by February 1, 1903, with a capacity of 500,000 pounds of wire and cables per month, working single turn. The sales department staff has been largely added to, on account of this new departure and the general increase of business. The general sales department with headquarters in Pittsburg, together with the branch office managers at New York, Philadelphia and Chicago, remains the same. Mr. A. B. Saurman, who has represented the company in Boston for the past few years, goes to San Francisco, where he is associated with Mr. C. F. Sloane, the Pacific coast sales agent of the company, Mr. Saurman devoting his attention exclusively to the interest of the company on the coast. The Boston office is now in charge of Mr. Frank Clarke Cosby, formerly the company's representative in St. Louis, and latterly connected with the sales department of the Westinghouse Electric and Manufacturing Company in New York city. The New York office force is augmented by the presence of Mr. H. P. Kimball, formerly with the Williamsport Electric Company. Mr. R. M. Hirst, for several years connected with the Philadelphia office, will devote most of his time to the trade in the territory covered by the Philadelphia office. The Pittsburg office will have two men constantly on the road, Mr. A. A. Anderson, who has been with that office for several years, and Mr. McBride, formerly with the Pittsburg Reduction Company. Mr. J. R. Wiley, at the Chicago office, will be assisted by Mr. E. J. Pietzcker, formerly with the American Steel and Wire Company.